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Global competences and education for sustainable development. A bibliometric analysis to situate the OECD global competences in the scientific discourse

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Abstract The Programme for International Study Assessment (PISA) regularly assesses a set of interdisciplinary competences in addition to the traditional core domains. With the 2018 assessment of ‘global competences’, the OECD (2019) aims to support evidence-based decisions on the improvement of the curricula and teaching in order to prepare young people to become active and global citizens who contribute to the achievement of the Sustainable Development Goals (SDGs). In assessing this domain, the OECD is entering a field of research characterised by dynamic debates and heterogeneous research strands. The aim of this paper is to visualise the theoretical foundations on which the analytical PISA 2018 Global Competence Framework (OECD 2019) is based, allowing a transparent discussion of the different theoretical reference points. The bibliometric analyses reveal that discourses related to Education for Sustainable Development (ESD) are hardly taken into account in the analytical framework. The paper subsequently formulates impetus from the ESD research field with the aim of linking discourses in the future.

Keywords Global competence · Education for Sustainable Development · Bibliometric analysis · VOSviewer · Scientific discourse

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Globale Kompetenzen und Bildung für nachhaltige Entwicklung. Eine bibliometrische Analyse zur Verortung der globalen Kompetenzen der OECD im wissenschaftlichen Diskurs

Zusammenfassung Neben den Basiskompetenzen wird im Rahmen der internationalen Schulleistungsstudie PISA regelmäßig eine Reihe von fächerübergreifenden Kompetenzen erfasst. Ziel der Erhebung der „Globalen Kompetenzen“ im Jahr 2018 war es, evidenzbasierte Entscheidungen zur Verbesserung von Lehrplänen und Unterricht zu ermöglichen. Ausgangspunkt hierfür ist das Bestreben, junge Menschen auf ihre Rolle als aktive und globale Bürger*innen, die einen Beitrag zur Erreichung der Ziele für nachhaltige Entwicklung (SDGs) leisten, vorzubereiten. Mit der Erfassung dieses Bereichs betritt die OECD jedoch ein Forschungsfeld, welches durch dynamische und heterogene Diskurse gekennzeichnet ist. Ziel dieses Papiers ist es, die theoretischen Grundlagen des analytischen Rahmenpapiers von PISA 2018 (OECD 2019) zu veranschaulichen. Dies ermöglicht eine transparente Diskussion der verschiedenen theoretischen Bezugspunkte. Die bibliometrischen Analysen zeigen, dass Diskurse einer Bildung für nachhaltige Entwicklung (BNE) in der Modellierung der „Globalen Kompetenzen“ bislang kaum berücksichtigt werden. Der Beitrag formuliert daher Impulse aus dem BNE-Forschungsfeld mit dem Ziel, die Diskurse zukünftig stärker miteinander zu verknüpfen.

Schlüsselwörter Globale Kompetenzen · Bildung für nachhaltige Entwicklung · Bibliometrische Analysen · VOSviewer · Wissenschaftlicher Diskurs

1 Introduction

The more education for sustainable development and global learning are embedded in the formal educational system, and the more governments and civil societies invest in this area, the more the effectiveness and efficiency of these contributions need to be considered. This progressive shift toward empirical educational research has been apparent for several years and is relevant to all fields of education (Zapp and Powell 2016). Evidence is increasingly becoming the basis for rational educational policy and practical decisions (Slavin 2020). One of the most significant and politically influential studies that collects data on school performance is the Programme for International Study Assessment (PISA). The classical competence domains in the PISA assessment comprise reading, mathematics and science. Respondents are 15-year-old students. The instruments used for the assessment of those domains are linked to the theoretical foundations of the respective disciplines and based on a shared basic understanding of the competence domain (for reading competence see e.g., Artelt et al. 2000).

In addition to the classic core areas, various interdisciplinary competences are regularly assessed. With the first-ever assessment of ‘global competences’ in 2018, the OECD however, has entered a rather new field of research. ‘Global competences’ attempted to measure intercultural competence and the knowledge required to deal with globalisation, that is, the knowledge needed to respond to changes in the world

of life and work as well as to meet global (learning) challenges (OECD 2015). One of the aims of the assessment was to inform evidence-based decisions with the objective of improving curricula and teaching in order to prepare young people to become active and global citizens “to support the Sustainable Development Goals” (OECD 2019). Therefore, the topic of sustainability is explicitly identified as a principal component of the global competence framework. However, simultaneously, a field of research was entered that is characterised by dynamic and heterogeneous discourses, multiple perspectives and normative settings. It is a truly interdisciplinary field of research, with various scientific disciplines contributing (to varying degrees) to the theoretical foundation of the concept of global competence. Accordingly, the framework and conceptualisation are subject to criticisms from various perspectives (e.g., Auld and Morris 2019; Costa 2022; Conolly et al. 2019; Kater-Wettstädt and Niemann 2019; Ress et al. 2022; Sälzer and Roczen 2018).

In view of the importance of the empirical findings for educational policy, it is of great importance that the scientific communities conduct a critical and reflexive analysis of the applied measurement tools. This paper contributes to the existing (theoretical) reflection on the used measurement instruments and the underlying conceptualisation for assessing global competences. By performing a bibliometric analysis, we aim to provide an additional contribution to the field and give an empirically based insight into the theoretical foundations of the framework (OECD 2019). A bibliometric analysis makes it possible to uncover implicit focal points and to point out possibilities for further development and connection (e.g., Waltman et al. 2010). Accordingly, the analysis allows an empirically based and transparent discussion of the (normative) premises and the different theoretical reference points from a meta-perspective. This article provides an overview to the existing (theoretical) reflection of the global competence research field, the used measurement instruments and different discourse strands accompanying it. Finally, the relationship with education for sustainable development will be a particular focus. Overall, the contribution is intended to serve as a stimulus for the further development of a model of global competences and its measurement, which needs to find its way into empirical educational research.

2 Global competence assessment in PISA 2018

In the assessment and analytical framework of PISA 2018, global competences are described as skills to “examine local, global and intercultural issues, understand and appreciate different perspectives and worldviews, interact successfully and respectfully with others, and take responsible action toward sustainability and collective well-being.” (OECD 2019, p. 166). The definition stresses the need to consider different areas, topics and research fields when conceptualising global competences. In addition to addressing questions of interculturality and good coexistence in society, it also incorporates aspects related to actively shape sustainable development. The fundamental legitimacy of the domain is built on these elements: Global competences are seen as necessary to live harmoniously in multicultural communities, to thrive

Global Competences (<i>operationalised aspects</i>)	
Scenario-based achievement test: Cognitive components	Questionnaire: Self-reported information
Global understanding Knowledge <ul style="list-style-type: none"> • <i>knowledge of global issues</i> • <i>intercultural knowledge</i> Cognitive skills <ul style="list-style-type: none"> • <i>Evaluate information, formulate arguments and explain complex situations or problems</i> • <i>Identify and analyse multiple perspectives and world views</i> • <i>Understand differences in communication</i> • <i>Evaluate actions and consequences</i> 	Knowledge of global and intercultural issues Ability to communicate in multicultural contexts Adaptability Perspective taking Attitudes <ul style="list-style-type: none"> • <i>openness toward people from other cultural backgrounds</i> • <i>respect for people from other cultural backgrounds</i> • <i>global-mindedness</i>

Fig. 1 Assessment domains in the PISA 2018 Global Competence Framework

in a changing labour market, to use media platforms effectively and responsibly and to support the Sustainable Development Goals (OECD 2019).

In line with the classic conceptualisation of competences in PISA (OECD 2019), the assessment of global competences distinguishes between knowledge, cognitive skills, social skills, attitudes and values. Different survey methods are selected for measuring the respective components. Competence measurement, which involves surveying knowledge and cognitive skills via achievement test, can be distinguished from the self-assessment of social skills and attitudes in the student questionnaires. Figure 1 summarises the methods and main content.

In principle, every standardised survey is necessarily characterised by a certain theoretical-conceptual setting and the determination of focal points. To allow quantitative measurement, it is necessary to narrow down big constructs and to simplify complex and fuzzy theoretical concepts (for operationalisation in the context of global learning see e.g., Scheunpflug 2020). However, the selection criteria and assumptions underlying the global competence assessment are sparsely described in the OECD framework (Bailey et al. 2023). Thus, it is difficult to unravel the theoretical perspectives, models and focal points represented by the final measurement instruments. This is problematic because it tends to reproduce existing narratives without reflecting on them (for a critical perspective on involved nodal actors with competing views and understandings in the development of OECD concept see Robertson 2021). It also makes working with the data and interpreting the results difficult.

This conceptual ambiguity in the framework are likely to be due to the complex genesis of the domain. Comparative analyses of different versions of the framework indicate that there have been significant shifts in emphasis and conceptualisation.

Formerly, there was a stronger focus on critical thinking and interculturality in the framework (Kater-Wettstädt and Niemann 2019). In the final version, the concept is more comprehensive, and aspects of sustainability have explicitly been added. One reason for this could be that, contrary to the measurement of other competences in the context of PISA, the measurement of global competences cannot rest on a consolidated and well-advanced research field. Instead, different existing research strands are combined and connected in this field. Therefore, the OECD is doing pioneer work in a new field of research. Even though the decision-making processes behind the whole concept are complex and we do not have detailed insights into the development of the framework, it seems necessary to systematically analyse which discourses have found their way into the final conceptualisation of global competences. This is especially important because global competences refer to different research strands, each with a certain perspective to contribute to the discourse.

3 Global competence as the core of different research strands

Various sociological analyses of society (e.g., Beck 2017; Robertson 1998) describe the developments towards a globalised (world) society which blurs national boundaries and confronts people with new (learning) challenges. The questions as to which key competences enable people to live in a globalised world society and which (learning) challenges we face have been discussed in educational science for decades.

The discussions are bundled in different, often interrelated and closely interlinked strands of discourse. Especially in German-speaking countries, these discourses take place, for example, in the field of global learning (e.g., Bourn 2020; Lang-Wojtasik and Klemm 2017; Scheunpflug 2021), Education for Sustainable Development (e.g., Barth 2016; Rieckmann 2022; Singer-Brodowski and Kminek 2023; Wiek et al. 2011), environmental education (e.g., Roczen et al. 2014; Monroe et al. 2019), intercultural education (e.g., Allemann-Ghionda 2009; Auernheimer 2016; Gogolin and Krüger-Potratz 2020) or (global) citizenship education (e.g., Abs 2021; Andreotti 2011; Lang-Wojtasik 2019; Pashby et al. 2020; Wulf 2021).

The list of research areas is not exhaustive, as questions about global challenges are also being addressed in other fields. Furthermore, the transitions between these discourses remain fluid, which becomes visible not least by the fact that different authors participate in different discourses. However, it illustrates the variety of discourses addressed by the comprehensive concept of global competence. The diversity of partly divergent perspectives may be one reason why there is no uniform and widely accepted model of competence. Rather, there is a variety of approaches to competence modelling, operationalisation and measurement in all of the different research strands, which are all united by the challenge of conceptualising and operationalising multifaceted and fuzzy competences.

4 Current study

The aim of this study was to empirically uncover and describe the theoretical foundations of the competence modelling and measurement of global competences in PISA by analysing the cited literature in the OECD's global competence framework. To this end, the leading question was: On which theoretical foundations is the modelling of global competences based and can discursive focal points be identified?

In view of the comments from the research community (e.g., Costa 2022; Kater-Wettstädt and Niemann 2019; Ress et al. 2022; Sälzer and Roczen 2018), the expectation was that there is a particular focus on aspects of interculturality since they were already included in the initial drafts. In addition, there is a long-standing discourse on intercultural competence that provides a solid theoretical basis for conceptualising and measuring intercultural competence (see e.g., Peng et al. 2020). This makes it even more likely to be prominent in the framework.

Expectation I Aspects of interculturality are rather prominent in the framework's references.

We also expected that topics that were added to the framework later in the process, such as sustainability, are not visible or less visible in the theoretical foundation. We assume this because the basic argumentation and the theoretical conceptualisation of the competence domain were already visible in the initial drafts, which were clearly oriented towards intercultural education and disregarded aspects of sustainability (see Kater-Wettstädt and Niemann 2019). Although this initial draft was supplemented and expanded in the further process to include aspects of sustainability, we assume that the basic argumentation and the theoretical points of reference have not changed.

Expectation II The discourse on Education for Sustainable Education is barely visible in the framework's references.

In a post-hoc analysis, we investigated the extent to which possible gaps in the theoretical references to ESD could be filled by ideas from the research community. For this purpose, the current ESD literature was reviewed with regard to possible suggestions for assessing and evaluating competence in the field of sustainability.

5 Methodological approach

As standard bibliometric analyses are not possible for OECD documents, an alternative approach was employed to analyse the literature references of the OECD framework for global competences. A co-occurrence analysis (COA) using the freely accessible VOSviewer software was conducted to systematically analyse all literature references related to the OECD's global competence framework (van Eck and Waltman 2010). In the following, the methodological approach is concretised by describing the COA and its fields of application in more detail and applying it to our specific analysis of the OECD framework.

5.1 Co-occurrence analysis

COA (sometimes referred to as semantic network analysis) is a technique used to identify patterns of co-occurrence or association between items in a dataset (Segev 2021). It involves analysing the frequency with which items appear together and determining if their co-occurrence is more frequent than what would be expected by chance. In co-occurrence analysis, the dataset typically consists of a collection of items, such as words in a text corpus, tags in a social media dataset, or products in a market basket. The analysis focuses on understanding the relationships and associations between these items. Co-occurrence analysis can provide valuable insights in various domains. It can map existing knowledge regarding a particular research field (e.g., Sharifi 2021). It can contribute to the analysis of scholarly communication by uncovering author networks (e.g., Qiu and Yu 2014). It can also identify product associations and compositions and help analyse consumer behaviour (e.g., Chazelas et al. 2020).

5.2 Co-occurrence analyses in the OECD framework for global competences

In our case, we are interested in mapping the theoretical foundations of the OECD framework for global competences by analysing the literature cited in the framework. While the development of the framework has already been analysed comparatively in a qualitative approach (Kater-Wettstädt and Niemann 2019), we aim to make the reference discourses in the final framework visible using a quantitative approach. An analysis of the cited literature provides insights into which research strands were included in the final conceptualization of global competences (Van Eck and Waltman 2007).

Therefore, we used the COA to visually describe the simultaneous presence of two terms in the same text unit (in our case titles and abstracts). Terms that co-occur more frequently are closer to each other than terms that co-occur less frequently. The strongest links between terms are displayed by lines. A number of closely related terms can form a cluster. This way, COA helps in understanding the patterns of co-occurrence between words but also concepts, ideas, notions and disciplines.

In total, 108 sources were cited in the framework. To prepare the data, all literature references were transferred to a literature management programme (Citavi). The available abstracts (100) for the references were also transferred to the literature management programme. Subsequently, the literature data were exported and read into the VOSviewer. In order to extract a list of the terms used in the titles and abstracts of the cited literature, the text mining function of the VOSviewer was used. A term had to be mentioned at least twice in either titles or abstracts to be included in the COA. The programme automatically excluded all word groups except adjectives and nouns, resulting in a list of 400 terms. For all terms, a relevance score was calculated. By default, the programme selects the 60% most relevant terms for the analysis. Hence, the number of terms was reduced to 240. In addition, country names, publication forms and fill words were excluded manually by the authors. For this purpose, the terms were rated by the three authors based on predefined criteria. A Fleiss kappa statistical analysis was used to measure the level of agreement among

the three authors. The overall Fleiss kappa value for interrater agreement was 0.84, indicating a strong agreement between the three raters. Any remaining discrepancies were discussed and decided upon in light of the context, in which the relevant term was used. This resulted in a total of 179 terms. The list of terms can be found in the Appendix (Table A).

The 179 terms were used to generate the maps shown in this study. For the text mining, binary counting was applied. Thus, occurrences indicate the number of text units in which a term occurs at least once (instead of counting the total number of occurrences). The sizes of the labels and circles are determined by the terms' number of occurrences. The resolution parameter was set to 0.70. It determines the level of detail of the clustering produced by the VOS clustering technique. The number of clusters is hence subject to the resolution parameter. Accordingly, clusters can only give a first impression of the actual theoretical foundations and careful interpretation is necessary. To allow better visibility, the 600 strongest links between terms are displayed.

6 Results

6.1 Descriptive analysis

To give a first overview of the references cited in the OECD framework, we will report descriptive results for the references. For this purpose, the publication years, form of publication and extent to which the literature is cited in the framework were analysed.

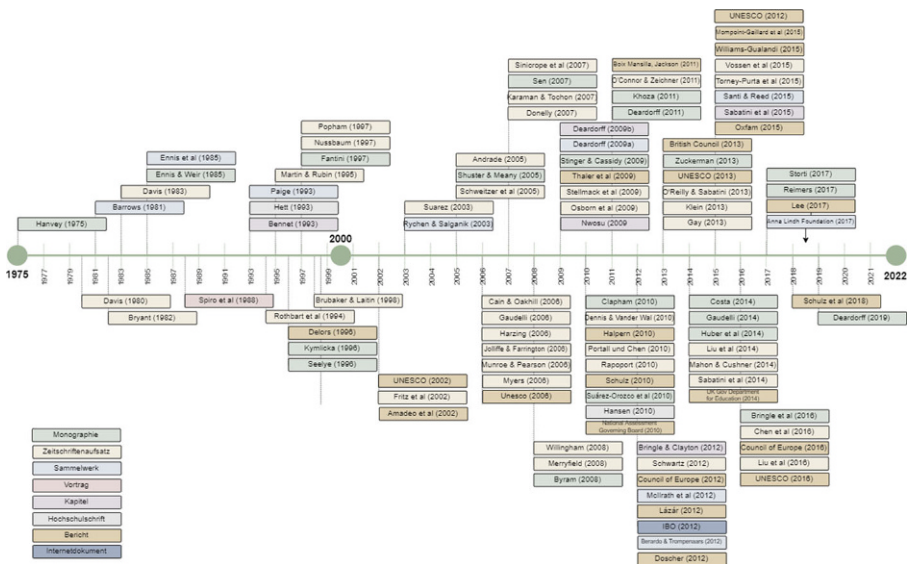


Fig. 2 Timeline with all references of the OECD framework

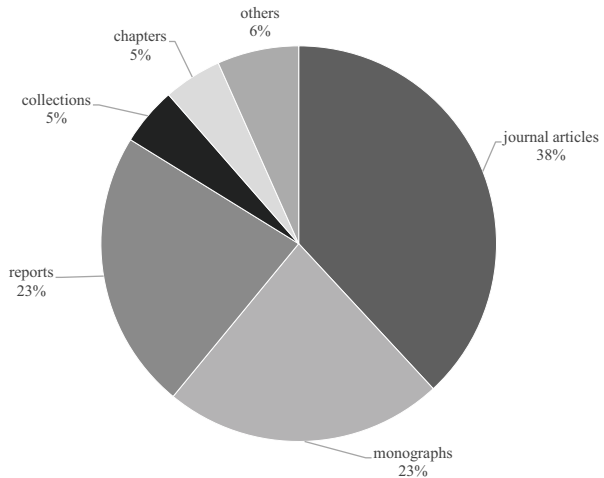
Fig. 3 Frequency of publication formats

Figure 2 shows a timeline on which all references are plotted. The majority of the cited literature was published between 2008 and 2015. The average publication year (rounded to full years) was 2007, which is comparable to the average publication year of cited literature in the PISA 2018 Reading Framework (2005), the PISA 2018 Mathematics Framework (2006) and all contributions to Issue 2, Volume 22 of the *Zeitschrift für Erziehungswissenschaft* (2006), which was published in the same month (April 2019) as the PISA 2018 Framework.

Figure 3 illustrates the frequency of different publication formats. Journal articles ($N=40$), reports ($N=24$) and monographs ($N=24$) were most often cited in the global competence framework.

In the majority of cases, the cited literature is referred to once within the main text in the framework (83%). There are only three references that are cited three or more times in the text, which may indicate higher relevance:

- Boix Mansilla, V. & Jackson, A (2011). *Educating for Global Competence: Preparing Our Youth to Engage the World*.
- Schulz (2010). *ICCS 2009 international report*.
- Council of Europe (2016). *Competences for Democratic Culture*.

6.2 Bibliometric literature review (co-occurrence analysis)

Figure 4 shows the results of the COA. A total of six clusters, indicated by the six different colours, was found. The most prominent cluster is probably the green cluster on the right side of the network. It contains terms like ‘reliability’, ‘measure’ and ‘instrument’. It also contains the biggest bubbles, indicating that these words occur more frequently. The purple, dark blue and red clusters are less prominent but nonetheless visually clearly distinguishable from the other clusters. The purple cluster at the top contains terms like ‘critical thinking’, ‘norm’ and ‘engagement’. The dark blue cluster contains terms such as ‘awareness’, ‘intercultural sensitivity’

and ‘cultural diversity’. The terms ‘citizen’, ‘citizenship’ and ‘global citizenship’ are at the core of the red cluster on the left side of the network. The yellow cluster (e.g., ‘science’, ‘reading’ and ‘curricula’) and the light blue cluster (e.g., ‘peace’, ‘job’ and ‘planet’) do not stand out visually and are not clearly distinguishable from the other clusters.

The network also shows that most links are within clusters. However, interrelationships between clusters exist, and there is no single centre in the network that connects with all clusters equally well. Instead, there are multiple small centres on the network’s border, leaving a rather blank space in the middle of the network. With regard to the quantity of terms, the red cluster is the biggest ($N=42$), followed by dark blue ($N=35$) and green ($N=34$) clusters. The light blue ($N=25$), yellow ($N=23$) and purple ($N=20$) clusters are smaller.

Many of the terms in the green cluster are related to *methodological aspects*, especially the terms ‘reliability’, ‘validation’, ‘scale’ and ‘item’. However, the cluster also contains other terms such as ‘child’ and ‘college student’ or ‘extraversion’, ‘empathy’ and ‘compassion’. The dark blue cluster with its terms ‘awareness’, ‘intercultural sensitivity’, ‘intercultural dialogue’ and ‘cultural diversity’ can be best described as the *intercultural cluster*. Not very surprisingly, the blue bubbles closer to the methodological cluster (e.g., ‘standard’, ‘methodology’, ‘factor’) fit less well in the intercultural cluster. Terms such as ‘citizen’, ‘citizenship’, ‘global citizenship’, ‘government’, ‘human right’ and ‘nation state’ in the red cluster point towards this cluster being the *civic cluster*. While this cluster seems overall rather homogenous, again, a few terms fit less well (e.g., ‘wide range’ and ‘threat’). In addition, some terms that seem suitable for the civic cluster are part of another cluster (e.g., ‘civic’, ‘democracy’, ‘democratic society’, ‘peace’, ‘policy’). However, these terms are located very close to the civic cluster and connect with the cluster’s terms through multiple links. The purple and the yellow clusters contain a number of terms that point to them being the joint *education/educational assessment clusters* (e.g., ‘higher education’, ‘next generation assessment’, ‘psychology’, ‘educational progress’, ‘high school student’, ‘curricula’). The light blue cluster is almost completely absorbed by the civic cluster and does not seem to have a theme that is easily distinguishable from the civic cluster. Table A in the Appendix contains a list of all terms, including their average publication year, frequency of occurrence and the cluster to which they belong.

6.2.1 Interpretation of the results in the light of prior expectations

Both of our expectations are supported by the COA results. With regard to expectation I, the COA shows multiple interconnected terms that describe aspects of interculturality. There is even a cluster (dark blue) that has interculturality as its specific theme. In terms of pure size, only the civic cluster is larger ($42 > 35$).

The result is even clearer when looking at expectation II. The term ‘sustainable development’ appeared only twice in the titles and abstracts of the cited literature and was located in the intercultural cluster. Other relevant terms such as ‘biodiversity’, ‘climate change’, ‘ecosystem’, ‘eco/environment-friendly’, ‘energy’, ‘environmentalism’, ‘recyclable’ and ‘sustainability’ were mentioned once or not at all. While

civic, intercultural, educational (and methodological) discourses have found their way into the PISA Global Competence Framework, aspects of sustainability and sustainable development seem to have played only an inferior role in the drafting of the framework.

7 Impetus from a neglected field: education for sustainable development

It is widely recognised that the complexity of global problems, which include climate change, social inequality, species extinction and pandemics, requires differentiated reflection on the potential of education and the definition of relevant key competences (e.g., Rychen and Salganik 2003; Wiek et al. 2011). One concept that has gained prominence in recent years and has become a guiding idea for the implementation and promotion of sustainable development is Education for Sustainable Development (ESD) (see UNESCO 2011). Despite the increasing relevance and visibility of the ESD research field, there is a lack of integration between the ESD discourse and global competences conceptualised by the OECD, which is apparent in the previous bibliometric analysis. This conclusion is further supported by a comparison of the framework's literature list and a list of the most influential works in the field of ESD identified in a scientometric analysis by Sivaraman and Naheem (2022). None of the most influential papers listed there (all published before 2016) are mentioned in the OECD's competence framework. However, if global competences are intended to contribute to the achievement of the SDGs, it seems essential to acknowledge and draw on the research findings of the ESD literature.

In our post-hoc analysis of the existing ESD literature, we identified several aspects that could be beneficial for future conceptualisations and operationalisations. The three stimuli presented in the following are the result of a comprehensive literature review to map the field of ESD research. The stimuli therefore remain selective but outline initial bridges and points of connection between the discourses. In this context, we have initially focused on academic discourse. Thus, we have not taken into account the contributions of political institutions (as e.g., UNESO), which, however, play a significant role in shaping the ESD field.

7.1 Approaches for transparently developing an agreed competency model

Identifying and assessing key competences through international large-scale assessments (ILSA) plays meanwhile an important role in optimising educational processes. It is perceived as a prerequisite for improving the effectiveness of education systems around the world (Leutner et al. 2017). It is not uncommon for the results of ILSAs to serve as the basis for educational policy decisions and reforms (for PISA see e.g., Hopfenbeck et al. 2018; for ICCS see e.g., Malak-Minkiewicz and Torney-Purta 2021). However, the formulation of theoretically well-founded competence models, which prove to be workable when used in empirical assessment, requires a great effort.

There are many papers in the ESD discourse that deal with defining and conceptualising key competences. This can be seen, for example, in bibliometric analyses of

the research field (e.g., Côrtes and Rodrigues 2016; Grosseck et al. 2019; Hallinger and Nguyen 2020; Wright and Pullen 2007). While some work on conceptualising sustainability competences relates to higher education (e.g., Brundiens et al. 2021; Wiek et al. 2011), there are also more broadly applicable models that aim to conceptualise sustainability competences also for younger students (e.g., de Haan 2008; Rieckmann 2018; Rieß et al. 2018; Wals 2010).

The ESD discourse on the conceptualisation of sustainability competences shows that it is a major challenge to systematise a relatively vague concept that is linked to many established concepts (e.g., critical thinking, communication skills, problem solving). A literature review by Wiek et al. (2011) reveals, that sometimes different terms are used for similar concepts. These conceptual ambiguities can only be addressed by clearly elaborating one's own approach in a differentiated manner and exactly defining the own concept.

Furthermore, the discourse points to the fact that the development of a recognised and validated model involves several steps, precisely because of the complexity and ambiguity of the domain. In the ESD research field there is clear progress in the conceptualisation of key competences in the last years. Within higher education, for example, Wiek et al. (2011) presented an overarching framework for conceptualising sustainability competences. It was further refined and updated using the *Delphi-Method* with international experts in sustainability education (Brundiens et al. 2021). This approach suggests that an agreed model needs to be (further) developed step by step, by engaging in discourse and involving experts of the research field.

Such overarching and integrating competence models have also been developed for younger students in recent years. Based on existing competence models, Rieß et al. (2018) developed a framework for basal and elaborated sustainability competences that can be used to locate and relate existing competence models and their operationalisation to each other. They differentiate between cognitive, affective-motivational and behavioural aspects in order to categorise sustainability competences into basal interdisciplinary and subject-specific as well as elaborated sustainability competences. They emphasise that existing and empirically tested operationalisations, such as questionnaire batteries and knowledge tests, can already be used to assess various facets of sustainability competence. The differentiation into subject-specific and interdisciplinary competences also draws attention to the fact that the interdisciplinary cross-sectional topic is dealt with in a wide variety of areas. This includes general educational science, but also subject-specific and subject-didactical research fields.

For a further development of the framework of global competences, such systematic and analytical framework models can help to clarify the position in the discourse and, moreover, point to gaps in the conceptualisation of global competences.

7.2 Existing instruments for measuring competences in ESD discourse

Although there is a broad discourse on the definition and conceptualisation of key competences, the practice of measuring competences in the field of ESD is still in its infancy (Waltner et al. 2019). Nevertheless, there have been several attempts to measure the competences students require for sustainability (for a systematic overview,

see Redman et al. 2021; Rieckmann 2022; Waltner et al. 2019). Looking at the trend over time, it becomes evident that the number of publications on the assessment of sustainability competences has increased significantly in recent years. Various tools are used to assess students' sustainability competences. Scaled self-assessments are the most common, followed by reflective writing and scenario/case tests. There are "clear signs of substantial investment in model and tool building [...], multi-methodological triangulations [...] and the piloting of innovative assessment tools" (Redman et al. 2021, p. 126). However, there is still a lack of linkage between different studies and a transparent justification of the selection. In this context, Redman et al. (2021) report that measurement instruments are often not well developed and that, despite many weaknesses, self-assessment tools are used because of the simplicity of their application. This self-critical examination of the use of instruments in the field of ESD could also enrich the discourse on global competences. The various attempts that have been made to assess competences relevant to sustainability can help uncover promising and innovative ways of measuring competences. To assess system competence, for example, concept maps are used to capture understanding of complex systems (e.g., Foley et al. 2017; Roczen et al. 2018). Other ways of assessing competence include, for example, reflective writing approaches. The complexity of this area requires a re-thinking and re-design of existing survey formats in order to address the specific challenges of the domain (Costa 2022).

7.3 Reflections on the objective of the assessment: instrumental and emancipatory ESD approaches

In addition to suggestions for the conceptualisation and measurement of competences for sustainable development, the theoretical discourse on ESD can also be useful for the reflection on the basic objective of the survey. Two schools of thought can be distinguished in the international discourse on ESD (Vare and Scott 2007). Wals (2011) refers to these two schools as the instrumental and the emancipatory approaches. Supporters of the instrumental approach are convinced that there are certain values and behaviours that are clearly linked to sustainability. Therefore, the aim of education is to foster certain values and behaviours (Vare and Scott 2007). Emancipatory approaches, on the other hand, are not focused on prescribing clear behavioural patterns. ESD is understood as an open process, as a societal movement of searching. Against this background, the aim of education is to encourage critical reflection on sustainability. Aspects such as complexity, uncertainty, contingency and contradictions also come into view (Vare and Scott 2007; Wals 2011).

This distinction between the instrumental and emancipatory approaches is crucial for the discussion of global competences. In the operationalisation presented by the OECD, there are at least in some parts references to instrumental approaches (e.g., when the questionnaire asks about sustainable behaviour without taking into account possible trade-offs and conflicts of goals). However, these references are not addressed or critically reflected. In view of the complexity of global societal realities, relying on instrumental approaches does not seem very promising. If the aim of a survey is to capture competences for achieving the SDGs and to connect to the reality of students' lives, it must include a critically reflective analysis of the

impact of one's actions in the context of specific economic and political systems. This promotes, among other things, a comprehensive and holistic understanding of ESD in which various social, cultural, economic and ecological aspects are included.

These theoretical discussions in the ESD research field uncover different goals of education, which also manifest themselves in concrete item construction. A reference to emancipatory approaches implies that aspects of critical analysis must be addressed in competence modelling. Likewise, the weighing of different criteria when deciding for an action and the critical elaboration of one's own perspective against a background of pluralism and contingency must be taken into account.

All in all, it is clear that there is an extensive body of literature that defines and concretises relevant key competences in the ESD discourse. The ideas outlined here provide only a limited insight into the multifaceted discourse, but could provide impetus for the further development of 'global competences'.

8 Discussion

The aim of this paper was to situate global competences, as presented by the OECD, in the scientific discourse based on a bibliometric analysis. To this end, the literature references from the OECD Framework were examined in a co-occurrence analysis. A total number of six clusters were identified based on the terms used in titles and abstracts. While some clusters do not seem to have a clear thematic background, four thematic focal points can be distinguished: methods, culture, citizenship and educational assessment. With reference to the expectations, it can be stated that there is indeed a focus on issues of interculturality. However, this finding should be put into perspective, as other thematic focuses (e.g., civic education) were also found. Thus, the bibliometric analysis revealed references to different research strands. However, it is also evident that, as expected, questions of sustainability do not form a thematic focus and are hardly considered in the framework.

Our methodological approach comes with certain limitations. COA is a powerful technique for gaining insight into frequently used terms in a text corpus. However, it does not provide information about the semantic meaning or contextual understanding of co-occurring words. This means that in our study we do not have any information about the use of the terms and the concrete discourses that are being represented. This would require a closer look at the clusters identified and the terms associated with them. For example, regarding the intercultural cluster, our analyses do not allow to conclude which cultural understanding is prominent. However, this close-up seems particularly relevant in diverse and heterogeneous fields where different meanings of terms are virulent. Our approach allows us to look at different keywords that appear in the titles and abstracts, but it is not possible to rule out the possibility that other aspects may be addressed and discussed in the full texts. Furthermore, the approach only provides an insight into the main topics that have been identified as relevant by the respective authors. Moreover, for a deeper understanding of the conceptualisation of global competences, it would be necessary to analyse in which parts of the OECD framework reference is made to which discourses. While our analyses do not consider the context of the citations, it would be

interesting for future research to include also which discourses are included as main and which as marginal discourses (e.g., by placing them in info boxes). Regarding the finally selected measurement tools, the question arises from which discourses the specific tools were adapted and what selection criteria guided this process. Despite the limitations outlined above, the methodological approach used in this study has made it possible to identify main thematic focal points. In the next step, this makes it possible to explore previously neglected areas of research.

Based on our findings, suggestions from the ESD research field were formulated post-hoc in this paper. The guiding idea was that it is beneficial to link the discussions, especially because the SDGs are a key reference point for the ESD discourse and global competences. We found that there are multiple discussions on the definition and selection of key competences in the field of ESD. These discussions draw attention to the need to clearly communicate one's own theoretical foundation and the selection criteria. Furthermore, it is apparent that a generalised competence is rarely assumed, but rather single sub-competences are formulated and their relationship to each other is measured. A corresponding holistic approach to sustainability is difficult to realise in a study like PISA. However, it seems promising to set clearer focal points in competence modelling in the future. A focus on more specific issues, topics and dimensions would allow individual aspects to become sharper and be captured in a valid way. For example, this could mean that the implicit focus on interculturality is turned into an explicit one. This allows for a more concrete discussion of the relationship to other concepts (such as transculture) and to situate the survey in current discourses in cultural and educational studies. With a more defined focus, the claim of the study and the objectives could be formulated more clearly and the connection to scientific discourses could be made more transparent. It is worth noting here that sustainability is also a key component of the PISA survey on scientific literacy, for which the framework paper has recently been published (OECD 2023).

In the end, however, it remains a balancing act between a comprehensive, holistic conceptualisation and an in-depth examination of individual aspects. A holistic framing increases the complexity and the necessity to deal with different perspectives and approaches to the topic, which is clearly demonstrated in the case of global competences.

In the operationalisation of global competences, a clear reference to the classical competence modelling of other domains in PISA (such as reading) is visible. This link is important and necessary. However, it should not lead to innovative formats in research being given less consideration. The discourse on measuring innovative competences with standardised measurement methods is also ongoing in the context of ESD. Promising approaches can already be found (e.g., Roczen et al. 2021, 2018; Waltner et al. 2019), but they must also be made usable for large-scale assessments in the future. For example, some existing measurement instruments are currently too long or involve complex procedures for data analysis, which makes it difficult to use them in large-scale assessments. For the future development of the concept of global competences, it would be important to discuss how existing instruments fit into the OECD approach, which aspects facilitate or also complicate integration.

To sum up, evidence-based educational research that focuses on the availability, development, and promotion of the relevant key competences required in a global world society requires innovative ways of measurement. The big challenge is that the complexity of the global and interconnected world must necessarily be narrowed down in the operationalisation. This requires formulating clear selection criteria in which the normativity of the topic is explicitly considered and reflected. Moreover, in view of the complexity of global social conditions, it no longer seems sufficient to follow simple ways of measuring competences (e.g., self-assessment). Rather, it is necessary to think about new and innovative measurement methods. The ESD discourse can offer valuable suggestions and concrete starting points for this.

Finally, it is important to emphasise that the lively discussions around the assessment of global competences indicate that this area is highly relevant to policy makers, business and academia. Ongoing discussions suggest that there is a growing field of research that includes interdisciplinary perspectives. Further developments in this area should be guided by critical but constructive feedback and by a lively discussion with a wide range of actors—including a variety of perspectives and different strands of research.

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