

# Systematization of Competence Assessment in Higher Education: Methods and Instruments

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**Abstract:** In a time of increasing digitalization, internationalization, and globalization, accompanied by corresponding adjustments and transformations, a central Higher Education (HE) objective is to prepare students for the professional world effectively. This is achieved through the continuous development of students' competencies. To facilitate this ongoing process, there is a need to streamline the assessment of key competencies in academic courses. This paper addresses this by conducting a systematic literature review (SLR) and subsequent expert interviews to comprehensively document and systematically analyze the methods and instruments employed in assessing students' key competencies in HE. This systematic analysis serves as a valuable decision-making aid and a source of inspiration for educators seeking to integrate competency-specific methods and instruments into their courses. Additionally, differences and parallels between theoretical literature and practical application are highlighted.


## 1 INTRODUCTION

In the era of increasing digitalization, internationalization, and globalization, adjustments and changes in HE are also intensifying (Blank et al., 2023; Mrohs et al., 2023). In this context, a central objective of HE institutions is to prepare students for the upcoming professional world, particularly regarding their competencies, including the so-called key competencies, as effectively as possible (Saas, 2023). Not only do the required competencies of students continuously evolve, but also the formats of examinations and assessment methods for measuring competencies adapt to the changing demands (Porsch & Reintjes, 2023). It is crucial to note that an appropriate evaluation or assessment method should be selected for each key competency acquired and developed by a student during their university journey. Only through a high alignment between the key competency under examination and the chosen assessment method can targeted development and evaluation of these competencies be achieved (Saas, 2023). This research paper addresses this point and provides an approach to systematize selected key

competencies in HE along with suitable assessment methods and instruments.

For the elaboration and categorization, it is essential to establish a unified understanding of terminologies and to delineate them from similar terms. The primary focus within the present work lies on the terms **key competencies**, **methods**, and **instruments**. When elaborating on key competencies, it becomes evident that a unified concept or understanding has not yet been achieved (e.g., Orth, 1999; Krüger, 1988; Weinert, 2001). This is partly attributed to the metaphorical nature of the term (Mugabushaka, 2004). Orth (1999) defines key competencies as acquirable general abilities, attitudes, and elements of knowledge that are useful in solving problems and acquiring new competencies in as many content areas as possible. The present research work builds on this understanding while complementing it with the HE context. In addition to Orth, models proposed by Krüger (1988), Mertens (1991), Welbers (1997), Münch (2001), Weinert (2001), and Chur (2002) further contribute to defining the term in relation to HE. Through a comparison of existing models, the following essential key

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competencies in HE emerge (s. Table 1), serving as the subject of investigation in this study.

Table 1: Overview of the most relevant key competencies of students.

1. Critical Thinking	5. Digital Competence
2. Communication Competence	6. Self-Reflection and Metacognition
3. Self-Management and Time Management	7. Intercultural Competence
4. Teamwork and Social Competence	8. Creativity and Problem-Solving

When defining *competencies*, it is important to distinguish it from the term »skills« or »abilities«. Skills describe specific, learnable actions, while competencies encompass a broad spectrum of skills, knowledge, and attitudes that can be applied in complex situations (Hain, 2019). In the context of assessing and evaluating key competencies, methods refer to procedures and approaches used for competency assessment. At the same time, instruments represent the specific tools or measures employed within these methods to assess and measure competencies. Methods determine the framework and structure of the assessment, while instruments constitute the specific elements used within this framework to collect data and assess competencies (Galuske, 2013; Geißler & Hege, 2007).

Looking at the key competencies to be investigated, it becomes clear that all thematically relevant papers address only isolated key competencies, and thus, a comprehensive overall view is lacking. Furthermore, only individual methods and instruments are addressed in each case, and a comprehensive linking or assignment of multiple forms is only done in specific instances and not thoroughly. This justifies the need for a comprehensive presentation and assignment of key competencies and corresponding assessment methods to close this research gap.

As the current state of research indicates, no existing approaches systematically consolidate methods and instruments for assessing students' key competencies. The relevant papers primarily investigate individual key competencies using quantitatively measurable approaches. These approaches include conducting surveys using instruments such as multiple-choice, self-assessment, and short questions to determine the development of knowledge and competencies within a predefined period and subsequently statistically analyze them. This approach is employed by various researchers (e.g., Brasseur et al., 2013; Yang et al., 2016; Stanley

& Bhuvaneswari, 2016; Soeiro, 2018; Lucas et al., 2022). Selected instruments for competency assessment are detailed in the works of Bray et al. (2020); Birdman et al. (2021); Van Helden et al. (2023); Pavlasek et al. (2020); Heymann et al. (2022); and Lucas et al. (2022) for measuring specific key competencies. However, only a few assessment methods are recurrently mentioned in the literature. Additional methods, like portfolios, storytelling, or presentations, are employed by Caratozzolo et al. (2023); Kleinsorgen et al. (2021); and Squarzoni & Soeiro (2018) for competency measurement.

Moreover, all papers focus on different scientific and university domains, often with a specialized emphasis. Therefore, a comprehensive overview of the entire HE sector can only be achieved by consolidating all research papers.

As mentioned, not every key competency can be assessed and measured using the same assessment method or instrument. Considering the existing research field, it can be inferred that a suitable assignment or systematization is currently lacking, making precise selection of suitable methods and instruments more challenging for educators. The assessment of key competencies no longer aligns effectively with one-size-fits-all solutions such as traditional exams. Educators lack guidance on which methods and instruments to employ as assessment formats for various key competencies. This research addresses this gap and introduces an initial framework for a concrete decision guide to systematize diverse assessment formats for each key competency. This aim leads to the following research questions (RQ):

**RQ 1:** What methods and instruments are employed for assessing students' key competencies in HE teaching?

**RQ 2:** What differences exist between the practice and the literature in their usage?

**RQ 3:** How can instruments and methods for explicitly applying and assessing key competencies be systematized?

To address the research questions, the explanation of the methodological approach follows the introduction. This section elaborates on the research methods of SLR and guided expert interviews. The methods were chosen to establish a robust theoretical foundation using an SLR and, subsequently, to conduct guideline-based interviews to complement practical insights. The data analysis and synthesis are conducted following the frameworks provided by Kitchenham (2004) and Kuckartz & Rädiker (2022). The results from the SLR and expert interviews are systematized and presented in the third part of the

paper. Subsequently, the discussion section critically examines possible conclusions, includes a decision guide for educators, and derives recommendations for action. The paper concludes by addressing the study's limitations and providing an outlook.

## 2 METHODOLOGY

The present study consists of two qualitative approaches, the SLR and the following guided expert interviews, to address the research questions. The SLR was necessary to provide a solid foundation in the literature for reviewing and analyzing existing research to provide the basis for a well-prepared qualitative analysis. Expert interviews were chosen as a method to compare and enrich the results from the literature with the experiential insights of practitioners.

### 2.1 Systematic Literature Research

Systematizing methods and instruments for capturing students' competencies requires an interdisciplinary analysis of existing research findings. Therefore, an SLR was conducted, utilizing the framework provided by Kitchenham (2004). The framework is structured into three phases:

**Planning:** Specification of the research question, development, and validation of the research protocol.

**Execution:** Identifying relevant research, selecting primary studies, evaluating study quality, extracting data, synthesizing data.

**Documentation:** Assessment report and validation.

For the analysis, four databases from the disciplines of Computer Science and Communication (IEEE Xplore), Psychology and Sociology (APA Psycinfo), and Higher Education (IBZ Online and Academic Search Elite) were employed to ensure a broad search field. The databases were chosen thematically in line with the research questions. The following search string was used:

»Methods OR Tools OR Instruments OR Measures OR Techniques (AND) Key Competences OR Core Competences OR Key Skills OR Core Skills (AND) Assessment OR Evaluation OR Rating OR Analysis OR Estimation (AND) higher AND Education«

The search was restricted to the period from 2013 to 2023 to account for possible changes in methods and instruments over time. The selection of publications was made in both English and German.

To objectively select publications based on titles and abstracts, criteria were formulated, requiring explicit mention of key competencies, methods, and/or instruments for capturing key competencies, as well as an academic context. The full-text analysis was based on five key points: methods and instruments used, prerequisites, application, advantages and disadvantages, and addressed key competencies. Full texts that included the five basic criteria were selected for the present study. Additional criteria that were also considered included consideration of sample sizes, research environment, journal rankings, and methodology.

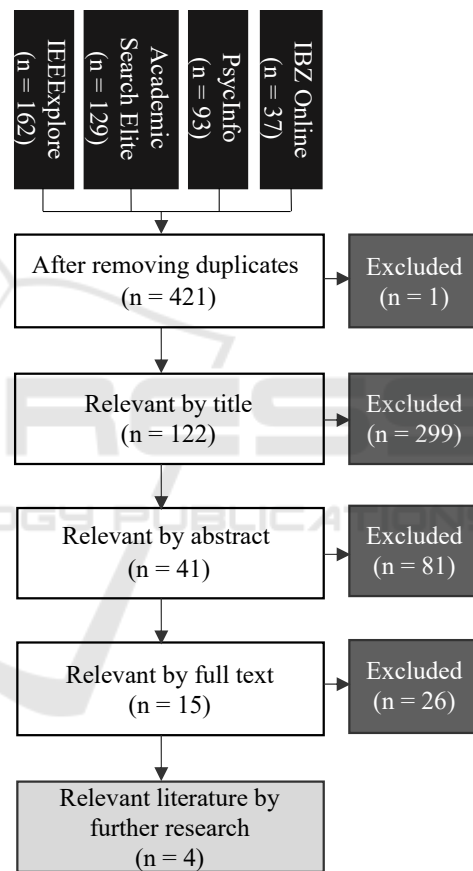


Figure 1: SLR Results.

### 2.2 Guideline-Based Expert Interviews

For comparison and enrichment of the results from the literature, interviews with experts from the field were conducted (Misoch, 2015). Experts were selected based on their specialized expertise and practical experience in their respective areas, as well as on the recommendation of a research network. Additionally, they were required to meet one or more of the following criteria:

- Engagement in HE teaching,
- Consulting or academic employment,
- In-depth experience in capturing students' competencies,
- Contribution to the development of didactic tools.

In this context, and due to their suitability for the topic, four people covering areas such as information management, e-learning within interdisciplinary learning, program development, and digital innovation and participation were chosen as experts. The interviews took place from 19<sup>th</sup> - 24<sup>th</sup> October 2023, using the recording function of Microsoft Teams. The interviews were guided by a questionnaire covering aspects such as personal background, experiences, expertise in the subject matter, and additional insights for the research. Subsequently, the approach by Kuckartz & Rädiker (2022) and the software MAXQDA were applied for data analysis and synthesis, utilizing the structuring qualitative content analysis method. All derived results will be listed in the online appendix. The material underwent several coding cycles with inductively formed categories (Appendix A). The preliminary material processing involved transcription using the smoothing transcription rules, according to Dresing & Pehl (2018). The process is portrayed in Figure 2.

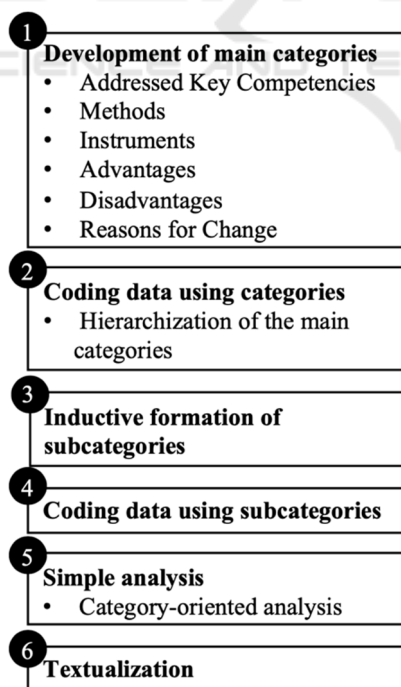


Figure 2: Structure of qualitative content analysis Kuckartz & Rädiker (2022).

### 3 RESULTS

The results from the SLR and interviews are presented in the following chapters, along with the derived systematization of methods and instruments for competence assessment.

#### 3.1 SLR Results

The SLR analysis fundamentally enabled the focus on eight key competencies within higher education, derived from their frequency of mention in the publications (Appendix D and Appendix E).

Furthermore, through the SLR analysis, existing instruments and methods for capturing students' key competencies were identified. The examined publications addressed existing competency assessment methods (twelve publications) or existing instruments (14 publications). However, there were partial overlaps between these publications (nine publications). In delineating the methods and instruments, their categorization into different formats (written, oral, physical presence, digital, asynchronous, observation) was realized. The application forms and examples of identified methods and instruments are presented in Table 3.

Table 3: Literature - Identified Methods and Instruments.

Methods		
Format	Papers/ Mentions	Associated Methods
Written	8 / 16	Case study work (P8); Essay (P9, P10, P13, P14); hands-on practice (P13, P14); Peer Review (P9)
Oral	5 / 6	Group examination (P2); Reflection discussion (P19)
Physical presence	3 / 4	Experiment (P8); Discussion (P10)
Observation	3 / 4	Observation in seminar (P15, P17)
Instruments		
Written	12 / 21	Multiple Choice (P1, P5, P8, P11, P13, P14); Reflection sheets (P15), (P16, P18); Likert Scale (P1, P3, P7)
Digital	5 / 6	Simulation (P2); Multiple Choice (P4, P13, P14)
Asynchronous	1 / 1	Self-assessment questions (P5)
Observation	1 / 1	Observation protocol (P15)

The identified methods for competency assessment included the formats of »Written«, »Oral«, »Physical presence«, and »Observation«. Conversely, for the instruments, the formats »Written«, »Digital«, »Asynchronous« and »Observation« were delineated. The overview showed that the publications concerning the listed methods emphasized the written assessment formats. Eight publications (with a total of 16 mentions) focused on this format. A similar outcome was observed for the format of the investigated instruments in the publications. Twelve publications (totaling 21 mentions) addressed the written format of competency assessment instruments (Table 3).

### 3.2 Expert Interviews

The four interviews (I1, I2, I3, and I4) with experts from the field confirmed various findings from the literature or supplemented them with practical experience. This validation from the interviewees enriched the selection of key competencies derived from the analysis of the SLR (Table 4) based on their practical insights. Furthermore, an evaluation was conducted to determine if the application formats of methods and instruments for competency assessment align with the results of the SLR analysis (Appendix B). This alignment was partially confirmed. Similar to the SLR analysis, the interviewees listed the application formats »Written«, »Oral«, »Presentation«, and »Observation« for the methods. However, these results were supplemented by the interviews with the formats »Digital« and »Asynchronous«. The focus on the mentioned methods was on written methods (37 mentions), oral methods (29 mentions), and methods conducted in physical presence (24 mentions) among the interviewees. For the instruments, the interview results included the application formats »Written« and »Observation«, similar to the SLR analysis. However, these were supplemented by »Digital« and »Asynchronous«, with the application forms »Oral« and »Presentation« being excluded. The focus was on the written formats of instruments (14 mentions). Within the listed formats, additional methods and instruments were derived from the interviews (Table 4).

Table 4: Interviews - Identified Methods and Instruments.

Methods		
Format	Interviews/ Mentions	Associated Methods
Written	4 / 37	Peer Reviews (I1, I2, I3); Exam (I1, I2, I3); Portfolio (I1, I3, I4)
Oral	4 / 29	Discussion (I1, I2, I4); Group examination (I1, I2, I4); (Deep-) Interview (I2, I4)
Digital	3 / 12	Blogpost (I1); Flipped Classroom (I1, I4); Presentation (I1)
Physical presence	4 / 24	Reflection discussion (I1, I2); Group examination (I1, I4); Oral Exam (I2, I3, I4)
Asynchronous	3 / 9	Video tutorial (I1); Blogpost (I1); Home- and seminar work (I3, I4)
Observation	3 / 4	Observation in digital interaction traces (I1, I4); Scientific practical examination (I3)
Instruments		
Written	3 / 14	Multiple Choice (I1, I3, I4); DigCompEdu (I1, I4); Self-assessment questions (I1, I4)
Digital	2 / 3	Simulation (I2); Multiple Choice (I1)
Asynchronous	2 / 2	Self-assessment questions (I1, I4)
Observation	2 / 5	Rubric matrix (I1); Observation sheets (I4); Social Learning Analytics (I1, I4)

### 3.3 Systematization for Competence Assessment

The systematization aims to associate methods and instruments for assessing students' competencies with the corresponding key competencies. Thus, the systematization allows the selection of appropriate methods and instruments based on the identified key competencies. As a preliminary step to the systematization, the results of the SLR analysis and the interviews were summarized and organized in a case-category matrix (Appendix B). The basic structure of the case-category matrix is presented in Table 5, showing the main categories, and the specified subcategories 1 and 2 (Kitchenham, 2004;

Okoli & Schabram, 2010). The complete listing of all categories from Table 5 can be found in Appendix B.

Table 5: Basic Structure of the Case-Category Matrix.

Methods		
Main	Sub 1	Sub 2
Addressed key competence	Listing of key competences	-
Methods	Application forms	Breakdown of the methods
Instruments	Application forms	Breakdown of the instruments
Advantages	Breakdown of the advantages	-
Disadvantages	Breakdown of the advantages	-
Reasons for change	Breakdown of the reasons for change	-

The cases represent the examined interviews or publications. The categories are further subdivided into subcategories, which emerged during the coding of the interviews and were accordingly applied for evaluating the publications. The main categories outline the critical points highlighted by the publications or interviewees so that, in addition to the mentioned key competencies, methods, and instruments, the identification of advantages, disadvantages, and reasons for change could also be identified. In subcategories 1 and 2, the main categories were specified. Using the case-category matrix, the results of the literature and interviews were compared, and the methods and instruments were categorized accordingly, leading to the derivation of the systematization. However, advantages, disadvantages, and reasons for the change were not included in the derivation of the systematization, as these results were incorporated to understand why specific methods and instruments were listed.

The derived systematization (Figure 3) represents a decision matrix specifying which instruments or methods are suitable for capturing key competencies (Appendix C). It also indicates the formats in which these methods and instruments can be applied. Thus, it is possible to derive the appropriate methods and instruments based on the desired key competencies. The systematization compares literature and practice, allowing users to distinguish which approach best suits their intended goal.

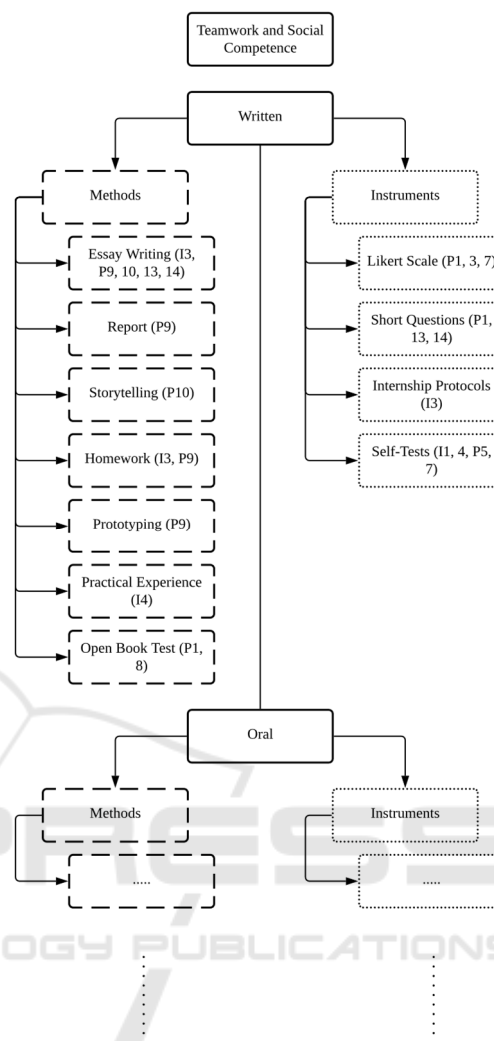


Figure 3: Systematization for Competence Assessment.

## 4 DISCUSSION

The interviews with experts from the field confirmed the relevance of systematizing methods and instruments for capturing students' competencies. As the results showed, the demands for competency assessment have increased in the last ten years due to digitalization and globalization (I1), as well as higher interdisciplinarity (I1; I3), and the shift to the new generation of Digital Natives in the workplace (I1; I4).

The results from the SLR and interviews with experts in the field allowed for identifying various methods and instruments for capturing students' key competencies. Furthermore, the formats of these methods and instruments were outlined. Additionally, eight key competencies were defined for this work,

focusing on those emphasized in both literature and practice. Developing key competencies and suitable methods and instruments for their assessment facilitated answering RQ 1. The results also led to the derivation of a corresponding systematization in the form of a decision matrix addressed to HE instructors, thus addressing RQ 3. Within the systematization, the results were categorized based on their origin (literature or practice), addressing RQ 2 and facilitating a comparison between literature and practice. The results highlight several factors to consider within the systematization. On the one hand, the listed methods or instruments can be utilized for multiple key competencies, assessing several competencies with a single method or instrument, and making them versatile. For example, the method of Practical Exercise can address the following competencies: self-reflection, creativity and problem-solving, critical thinking, communication, teamwork, and social competence (Appendix C). Instruments like the Likert Scale can also be employed for various competency assessments (Appendix C).

On the other hand, the interviews revealed that the chosen key competencies sometimes overlap, and a complete separation is not always possible. This is because key competencies in HE are viewed from different perspectives, highlighting various aspects and divisions (I1). Therefore, it is recommended to use different methods and instruments to cover a broad spectrum of competencies.

As outlined in the Chapters 3.1 and 3.2, the results of the literature and interviews also showed a strong focus on written formats of methods and instruments for competency assessment. Reasons for this include reducing the effort (I1, I2, I4) of competency assessment and being able to provide the necessary human resources (I3). Furthermore, methods and instruments of this format allow for a more accurate and objective assessment of competencies (I1) and a direct assignment to the respective individuals (I1). Additionally, the results indicated that individual methods and instruments were mentioned more frequently in practice than in the literature (Appendix C). Even though there was greater diversity in methods in practice, it was clear that some methods were only applied in limited timeframes or specific course contexts (I3). The application of the systematization presents certain challenges that need to be considered for using methods and instruments. For example, inhibitory data protection regulations for competency assessment forms (I1, I4) or increased effort in implementation (I1, I3, I4). The personnel resources for more competency orientation in the course pose a challenge (I2, I4) and the higher

time expenditure for competency assessment (I2). Moreover, factors such as students' active participation and involvement in competency-assessing courses (I1) or the context-dependent application of methods (I3) can complicate competency assessment. In general, courses must be legally secured per examination regulations (I2, I3).

Therefore, such challenges in the application of competency-assessing methods and instruments must be considered by instructors when using the systematization. Fundamentally, for the successful selection of suitable methods and instruments from the developed systematization, the procedure depicted in Figure 4 should be followed.

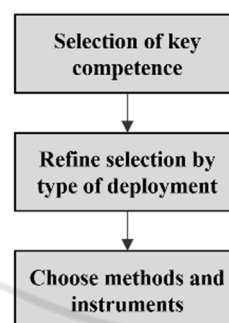


Figure 4: Selection Process of Methods and Instruments from the Decision Matrix.

The systematization and the resulting decision matrix, as previously outlined in Chapter 3.3, enable the selection of suitable methods and instruments for capturing students' key competencies. Thus, it can be considered a foundational element for a reference tool. The particularity lies in explicitly selecting the key competencies to be assessed. For an even more specific selection, the type of deployment (written, oral, digital, physical presence, non-presence, observation) can be chosen, ensuring a precise alignment of methods and instruments with the instructional format.

## 5 CONCLUSION AND LIMITATIONS

By conducting an SLR analysis and four interviews with experts from the field, this study successfully addressed the research questions RQ 1 - 3. Consequently, the developed systematization can illustrate the current state of research and the practical perspective regarding the assessment of key competencies using appropriate methods and instruments. Therefore, this study contributes to the

design of courses aimed at competence-based assessment. While the systematization serves as an initial compilation for a reference work, it requires expansion. There is potential to enhance the systematization by supplementing listed methods and instruments with new insights. The developed search string represents another limitation of the study. It should be noted that it could also be expanded to include the term »key qualifications«, as the existing definitional concepts do not reveal a clear and consistent usage of terminology. It must be considered that different approaches, as mentioned in the introduction, often use different terms for the concept of »key competencies« while meaning the same thing. However, this SLR's terminology was limited to »key« and »core competencies«. Additional synonyms might be used in further research.

In its current stage, the systematization presents a catalog of all significant key competencies and associated methods and instruments for their assessment. It specifies these methods and instruments regarding their formats, allowing for more targeted selection. This overview provides educators with inspiration for their teaching activities. However, for further support, it should be complemented with guidelines illustrating how to correctly apply the methods and instruments, including their pros and cons. This enhancement would enable educators to make more precise and time-efficient choices, reducing reliance on external sources. Integrating the systematization into a digital tool is considered advantageous for future applications to reduce accessibility barriers. Moreover, additional connections between individual key competencies, methods, and instruments can be incorporated, especially in intercultural competencies. Although the article highlights the relevance of the systematization through existing literature and insights from practice, practical validation of this approach is pending and should be addressed in future research.

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