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Towards a method for comparing curricula

Jackie Greatorex, Nicky Rushton, Tori Coleman, Ellie Darlington & Gill Elliott

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Author contact details:

Jackie Greatorex, Nicky Rushton, Tori Coleman, Ellie Darlington & Gill Elliott

Assessment Research Development
Research Division
Cambridge Assessment
The Triangle Building
Shaftesbury Road
Cambridge
CB2 8EA
UK

Greatorex.j@cambridgeassessment.org.uk

http://www.cambridgeassessment.org.uk

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Abstract

A curriculum map is a visualisation of relationships within and between a curriculum or curricula. Curriculum mapping refers to the method for creating and using the curriculum map, however this term is used broadly and encompasses a variety of methodological approaches. Often, researchers in the field of curriculum studies conduct curriculum mapping specifically to compare two or more curricula using documentary evidence. There is a paucity of literature articulating how to conduct curriculum mapping that is replicable. Therefore, our article draws on current literature as well as our personal experiences in order to construct a methodological approach for making such comparisons. To begin, the concept of curriculum mapping will be explained. Next, the key stages of the curriculum mapping process will be discussed. Finally, the benefits and limitations of this method will be explored.

1. Introduction

Often, the Cambridge Assessment Research Division compares curricula using documentary evidence. One way of comparing curricula is to complete a curriculum mapping exercise. As with any piece of quality research, the methodological approach must be sufficiently transparent in order for others to understand the process, draw conclusions, and potentially replicate it. However, in the case of curriculum mapping, there is little literature available which explains replicable methods (Elliott, 2014; Ervin, Carter, & Robinson, 2013). This article will contribute to filling this void by describing and a methodological approach that can be used in curriculum mapping studies. In addition, the benefits and limitations of this method will be explored.

2. Defining curriculum mapping

Broadly speaking, a curriculum map is a visual representation of components and characteristics of a curriculum so that the constituent parts are visible, thus allowing for easier review and potential comparison (Angelos & Guy, 2011; Elliott, 2014; Harden, 2001; Sumsion & Goodfellow, 2004). In other words, a curriculum map makes curricula more transparent and demonstrates the links between elements within, or between, different curricula. Curriculum maps are often presented as charts, diagrams, networks, and other graphical representations. Curriculum maps often include the declared, taught, and learned curriculum as well as relationships between them (English, 1978). That is, a curriculum map frequently includes what it is intended the students learn, what is actually taught, and what students achieve, as well as the relationships between them. Clearly displaying this information can facilitate a deeper understanding of curriculum progressions and can be used as a tool for curriculum review and curriculum development (Burwash & Snover, 2016; Ervin et al., 2013; Uchiyama & Radin, 2009).

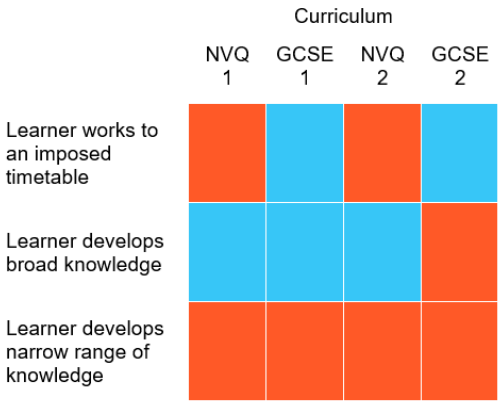
An example of a simple curriculum map can be seen in Figure 1, which includes an extract from a simple curriculum map comparing the National Vocational Qualifications (NVQ)[1] and the General Certificate of Secondary Education (GCSE)[2] in the field of Health which was derived from the results of Greatorex, Mehta, Rushton, Hopkin & Shiell (2011).

Curriculum map example 1 – Presence and absence of features in qualifications

	Curriculum			
	NVQ 1	GCSE 1	NVQ 2	GCSE 2
Learner develops procedural knowledge	✓	✓	✓	×
Learner develops factual knowledge	✓	✓	✓	✓
Learner organises their own time to complete task	✓	×	✓	×

Note: A tick indicates that the curriculum has a particular feature. A cross indicates that a feature is absent

Curriculum map example 2 - Heat map of features in qualifications



Note: Blue shading indicates that the curriculum has a particular feature, red shading indicates that the feature is absent.

Figure 1: Simple curriculum map comparing NVQs and GCSEs

3. Key stages of the curriculum mapping method for comparability research

The following section describes stages of curriculum mapping for comparing documented curricula. This is only one type of curriculum mapping Table 1 lists and describes the key stages in curriculum mapping Table 2 summarises the key stages as used in three selected studies.

[1] National Vocational Qualifications are qualifications which credit occupational competence in England.
[2] A GCSE is a national public examination sat by most 16-year olds in England.

Table 1: Key stages of the curriculum mapping method

Key stage	*Description*
1. Define study aims and use	The aims of the study and how it will be used
2. Decide which curricula will be considered	The curricula to be compared
3. Determine the curriculum features that will be the basis of comparison	A set of dimensions used to compare the curricula, such as a list of subject content
4. Collect relevant documentation and sources of data	Information about curricula, such as subject content, documents describing the curricula, academic literature, textbooks, and so on
5. Extract data and input it into the standard instrument	Experts consider the data and record information about each curriculum into the standard mapping instrument
6. Consolidate findings through visual representation	Presenting the judges' work in a way that represents the relationships within, and between, curricula

4. A guide to undertaking curriculum mapping

The section below is a guide to undertaking curriculum mapping. Outcomes or products of work from each stage will be explored. The stages are shared in the order in which they are performed, although some of the stages can happen concurrently. For example, assembling data and determining features may occur in tandem. In addition, some stages may be repeated in a cyclical manner. For example, after stage 5 it may be decided that more data is needed to answer the research question and stages 4 and 5 are repeated.

4.1 Defining the aims and purpose of the study

The first stage of a curriculum mapping study is to clarify the aims, parameters and purpose of the work (Harden, 2001). This includes considering the potential uses of the study's findings (Harden, 2001). For example, Bergeron's (2015) comparison of pre-university Mathematics curricula of high- performing jurisdictions, might be used:

- by governments to inform policy decisions about updating curricula, such as what content to add or remove;
- by universities to decide whether to admit students from particular countries; and
- by education researchers to inform them about the situation in which future research is undertaken.

Bergeron then shaped the curriculum study based on the aims of the research output. In this way, the aims and purpose of a research study shape the methodological approach of the research conducted.

4.2 Deciding which curricula will be considered

The next stage is identifying the curricula that is to be compared, which should largely be determined by the aims and purpose of the study. Decisions regarding which curricula should be included must be justified based on the aims and uses of the research. However, which curricula is excluded from the study may be influenced by challenges of access in addition to study aims.

When defining the parameters of the study, it is essential that clear definitions are given to the remit, jurisdiction, and type of the study. For example, if a curriculum mapping study is comparing curricula from high-performing jurisdictions, it is important to give clear justifications for classifying a given jurisdiction as high performing since a jurisdiction may be high performing on one indicator and low performing on another. The curricula that are selected should then fit these definitions.

4.3 Determining the key features of comparison

The next stage in the process of curriculum mapping is to determine which curriculum features will serve as the basis of comparison. The aims and purpose of the study should inform the key features of comparison and the level of detail required. In some cases the features already exist, for example, as a 'master curriculum' against which all other curricula are mapped (Elliott, 2014), or as a standard instrument (see Britton, Letassy, Medina, and Er (2008). An extract from a standard instrument is shown in Table 2, taken from Greatorex et al. (2011). Column 1 lists some of the key features on which the curricula will be compared, and therefore the rows are not numbered 1 through to 13. Columns 2-5 each refer to a

different curriculum, and provide space for judges to indicate whether the feature (in the row) is relevant to that curriculum.

Table 2: Curriculum mapping instrument taken from Greatorex et al. (2011)

Instructions

This research instrument was developed to systematically list features of different specifications and to identify the features present in different specifications.

Listed in the instrument are features of learning and knowledge which some specifications intend typical learners to experience. Please read the list carefully and tick the boxes to indicate the relevant features. The features may be explicit in the specifications or implicit and part of the underpinning ethos.

Please ensure you have familiarised yourself with the specifications before starting the task.

Feature Questions 1-19 are about **Learning**	*Indicate if feature is present in*			
	NVQ1	GCSE1	NVQ2	GCSE2
5. Learning in familiar situations				
6. Learning in unfamiliar situations				
7. Learner works individually				
8. Learner works in a group				
11. Learning in the classroom				
12. Learning in real-life practical situations				
13. Learning through situations that simulate real life				

If an existing master curriculum or standard instrument meets project requirements then no further work is required at this stage. When no standard instrument or master curriculum is available, the features need to be determined from the data, which is a multistep process as described below. A completed example is shown in Table 3.

A. From the data, make a list of all features on which the curricula may be compared, (see examples in columns 1 and 2 of Table 3). For example, Bergeron (2015) included lists of subject content, whilst Hodgen, Pepper, Sturman, and Ruddock (2010b) recorded whether subjects were compulsory or optional at a particular level of study.

B. Make a master list of key features.

C. Group the key features into themes, if possible. For instance, Bergeron (2015) compared pre-university Mathematics curricula in terms of the themes of Structure, Content, Cognitive demand, Philosophical underpinnings, and University recognition.

Each theme comprised various key features, for example, the Philosophical underpinnings theme included the key features of ‘enjoy Mathematics’ and ‘communicate Mathematics’.

D. Create a standard instrument (questionnaire, form, spreadsheet, grid, or matrix) for capturing the same information about each curriculum. Specimens of standard instruments are available in the literature (for example Britton et al., 2008; Greatorex, Mehta, Rushton, Hopkin, & Shiell, 2011; Harden, 2001; Spencer, Riddle, & Knewstubb, 2012). When a matrix or grid is used, there is usually a row for each key feature and each curriculum is given in a column, for example, Table 4, or Table 5. Judges can make comparisons of each feature in a variety of ways, depending on the project requirements. For example, Ervin et al. (2013) used radio buttons, Burwash and Snover (2016) asked judges to indicate which level in Bloom’s taxonomy was required, and Darlington (2017) asked judges to capture relevant summaries of references and quotations.

E. Add a space next to each question where judges can indicate the reference for the data as evidence for their response (e.g., see the reference and page columns in Table 4 and Table 5).

F. Pilot the standard instrument. For example, Sumsion and Goodfellow (2004) asked judges to complete the standard instrument and provide feedback, which was used to improve the standard instrument.

The product of this process is a standard instrument which will be the basis for organising the curriculum data and through which findings will emerge.

Table 3: Corresponding data, key features, and questions from a standard instrument

Data extract (features of curricula noted by experts)	*Feature*	*Extract from the key features instrument*	
		Instructions This research instrument was developed to systematically list features of different specifications and to identify the features present in different specifications. Listed in the instrument are features of learning and knowledge which some specifications intend typical learners to experience. Please read the list carefully and tick the boxes to indicate the relevant features. The features may be explicit in the specifications or implicit and part of the underpinning ethos. Please ensure you have familiarised yourself with the specifications before starting the task.	(Name of target specification)
Technical aspects of setting up for an event (stage management)	Procedure/declarative knowledge	Learner develops procedural knowledge	
		Learner develops factual knowledge	
Organising from own perspective and perspective of others involved	Self-organising versus set structure	Learner organises their own time to complete task	
		Learner works to an imposed timetable	
Broad knowledge required	Breadth and depth	Learner develops broad knowledge	
		Learner develops narrow range of knowledge	

Note: Derived from Greatorex et al. (2011) and Greatorex, Rushton, Mehta, and Grayson (2015).

Table 4: Extract from a hypothetical standard instrument

	Curriculum 1		
Are the following topics included in the curricula?		Reference	Page
Catalysts	Yes/ No		
Electrolysis	Yes/ No		
Periodic table	Yes/ No		

Note: Column 1 gives the topics. Columns 2-4 contain information about Curriculum 1 (a fictional curriculum). Column 2 gives the closed responses from which judges choose. Columns 3 and 4 provide space to record the reference informing the decision recorded in Column 2.

Table 5: Extract from a hypothetical standard instrument using Bloom's original taxonomy

What level of proficiency is required for each topic?	*Curriculum 1*			*Curriculum 2*		
		Reference	Page		Reference	Page
Catalysts	Evaluation/ synthesis / analysis/ application/ comprehension / knowledge			Evaluation/ synthesis / analysis/ application/ comprehension / knowledge		
Electrolysis	Evaluation/ synthesis / analysis/ application/ comprehension / knowledge			Evaluation/ synthesis / analysis/ application/ comprehension / knowledge		
Periodic table	Evaluation/ synthesis / analysis/ application/ comprehension / knowledge			Evaluation/ synthesis / analysis/ application/ comprehension / knowledge		

Note: Column 1 gives the question for judges to answer about listed subject content. Column 2 gives the response options. Columns 3-4 provide space to record the reference informing the decision recorded in Column 2.

4.4 Collecting relevant documentation and sources of data

Once the mapping tool is designed, fully or provisionally, relevant documentation must be collected so that data can begin to be inputted. It is essential that only relevant documentation is considered, therefore the parameters of what is considered relevant must be defined. Broadly there are three approaches to gathering sources of data:

1. **Consulting experts:** This approach is suggested by Elliott (2014). Advice takes many forms, from informal conversations to formal research interviews. An example of the latter is Greatorex et al. (2011) who interviewed subject experts about the similarities and differences between general and vocational curricula at the same level in the UK. These responses were inputted into the mapping tool and used as data.
2. **Official curriculum documents:** Government websites are a good source of policy documents and statistics (Elliott, 2014), which are often used in curriculum mapping (for example Bergeron, 2015; Hodgen, Marks, & Pepper, 2013a; Hodgen et al., 2010b). The Organisation for Economic Co-operation and Development (OECD); the World Bank; the United Nations Educational, Scientific and Cultural Organisation (UNESCO); and similar international organisations also offer information, statistics and research. A comparison might include data about participation rates at particular levels of education (for example Hodgen, Marks, & Pepper, 2013b).
3. **Searching related literature:** Literature may include academic articles, textbooks, as well as international studies such as Progress in International Reading Literacy Study (PIRLS) (Mullis, Martin, Foy, & Hooper, 2017), Teaching and Learning International Survey (TALIS) (OECD, 2014), TIMSS and the Programme for International Student Assessment (PISA) (OECD, 2009), journal articles, and so on. Examples of such literature reviews can be found in Bergeron (2015) and Hodgen et al. (2013a, 2013b).

Throughout this stage, researchers should keep a list of the data sources collected and the location of the data, such as web addresses or journal publications. The data list is used later in the method and is referred to as a 'reference list'. This list is also an important aspect of ensuring the curriculum mapping exercise is replicable.

4.4.1 Specific challenges when collecting sources of curriculum data

There are two key challenges when gaining data. The first is that some curricula do not have formal explicit documentation outlining the learning experience. For instance, NVQ's documentation only includes statements of the competencies to be assessed (Grugulis, 1998). In such cases, substitutes need to be found. Substitutes could include:

- awarding body[3] documents such as a specifications[4] (for example Bergeron, 2015; Darlington, 2017)

[3] An awarding body is an organisation which awards qualifications (also referred to as an examination board or assessment organisation).
[4] A specification is a summary of what is to be studied and assessed within a particular course (also known as a syllabus).

- subject criteria or subject content (for example Darlington, 2017), which provide the framework within which awarding bodies develop the detail of specifications (Ofqual, 2015, 2018)[5].

The second challenge occurs when data is not in the language(s) used by those conducting the study and translations are needed (Elliott, 2014). If a detailed understanding of the data is needed, then a human translation may be required. If a broad understanding of data is required then automated translation may suffice.

4.5 Extracting data and inputting it into the standard instrument

A key stage of curriculum mapping involves one or more judges using the data to complete the standard instrument. The judges read each question in the standard instrument, use the data list to find the data to answer the question, consider the data, and record a response in the standard instrument. Researchers conducting the study must choose one or more judges with the appropriate experience to make the necessary decisions (Ervin et al., 2013). Judges are usually researchers, country experts, or subject experts (for example Darlington, 2017; Greatorex et al., 2011; Hodgen et al., 2013a; Hodgen et al., 2010b; Spencer et al., 2012). The type of judge used may depend on the type of study. For instance, comparing countries requires country experts, whereas detailed comparison of subject content requires subject experts. Once commissioned, the judges are supplied with the data, data list, and the standard instrument, as appropriate. They make the judgements and complete the standard instrument. Researchers need to be available to respond to judges' queries. The outcome of this stage is the judges' responses to the standard instrument.

4.5.1 Studies with more than one judge

Studies can have a sole judge, for example, Darlington (2017), or several judges, for example, Greatorex et al. (2011); Hodgen et al. (2013a); Hodgen et al. (2013b); and Hodgen et al. (2010b). Having several judges brings with it additional considerations.

Researchers need to consider whether to assign the same task to each judge, or tailor the allocation to judges' expertise. However, these decisions should be based on what would best satisfy the aims and uses of the study. For instance, when comparing different subjects, judges may look only at data linked to their subject area, leaving the cross-subject analysis to researchers. In other cases, judges may compare across different subjects and present a comparative review. Another approach is a researcher making judgements which are subsequently checked by an expert. In other cases, the judges and the researchers may be the same individuals, so the division may become irrelevant.

In addition, since curricula are steeped in technical language, it is vital to ensure an agreed understanding of terms (Ervin et al., 2013). For instance, subject-specific terminology can lead to divergent understandings of terms (Hodgen et al., 2013b). A shared understanding is needed so that all judges complete the standard instrument in a coherent manner, which in turn boosts the reliability of the findings of the study. Therefore, it is important that there is an ongoing dialogue between judges to develop a shared understanding (Ervin et al., 2013).

5 The Office of Qualifications and Examinations Regulation (Ofqual).

Frequently, several judges respond to the same questions in the standard instrument. For example, in Greatorex et al. (2011), five health specialists made judgements on the same data relating to health qualifications. One reason for using multiple judges is minimising personal biases. Multiple judges also assist in making the curriculum mapping results more reliable or generalisable. Inter-rater agreement is often assessed using statistical measures (Coleman, 2017), including Cohen's kappa (for example Ervin et al., 2013; Liu, Chen, Yueh, & Sheen, 2014) and correlation (Stemler & Tsai, 2008). When multiple judges are used, they may make different decisions. In some research studies this may not matter. However, in many cases, a lead judge or adjudicator is appointed to make final decisions (Elliott, 2014).

4.6 Consolidate findings through a visual representation

The final stage is compiling visualisations and accompanying text in a report.

Visualisations are a significant aspect of curriculum mapping reports. Often, the visualisations are tables (for example Bergeron, 2015; Greatorex et al., 2011; Hodgen et al., 2010b; Sargent, Houghton, & O'Donnell, 2012). Other graphics include:

- heat maps (visual representation of data when the values in the matrix are represented by colours), for example, see Figure 1 or Spencer et al. (2012)
- networks, for example, see Harden (2001)
- Venn diagrams, for example, see Harden (2001).

With advancing technology, the possibilities for graphic representations are enormous. In short, there are multiple graphics available to use and the researcher's role is to choose the most suitable for presenting the information clearly and in a valid manner.

Turning now to the text in curriculum mapping reports, sometimes a report is not required as the visualisation is a discussion tool. In other circumstances, a full report shares the characteristics of a research report. As mentioned previously, it is good practice to describe the context of the research and the methodological approaches in full so that it can be replicated (see Darlington, 2017; Hodgen et al., 2013a, 2013b; Hodgen, Pepper, Sturman, & Ruddock, 2010a). Reports may also include a data list (reference list) and limitations, for example, see Hodgen et al. (2013b).

5. Overview of the key stages of curriculum mapping in practice

To present the six stages of curriculum mapping exercises in practice, Table 6 has been created. The table provides an overview of three curriculum mapping studies and illustrates how each stage was approached and achieved. Please see the relevant citations for further information regarding the methodological approaches of each study.

Table 6: Summary of selected curriculum mapping

Key stage	*Example of key stages in curriculum mapping*		
	Bergeron (2015)	**Greatorex et al. (2011)**	**Hodgen et al. (2010b)**
Aim and purpose/use	To review and compare established pre-university Mathematics qualifications from high-performing jurisdictions	To compare the knowledge and learning associated with cognate curricula from different types of qualifications	To ascertain whether the UK is unusual in requiring or enabling few learners to study Mathematics over the age of 16 years
	To investigate which forms of education are a good preparation for university in a variety of countries	To indicate whether the different types of qualifications were clearly different (if not, there is a case for adjusting the specifications or rationalising the number of qualifications)	To inform policy about whether learners should study Mathematics after the age of 16 years
Curricula	Mathematics curricula: International Baccalaureate® Diploma Alberta Diploma (Canada) Advanced Placement ® (US and Canada) A Levels (England and international) Gāokǎo (China)	Health curricula: NVQ1 NVQ2 GCSE1 GCSE2	Academic and vocational Mathematics curricula at Upper Secondary level from: Australia (New South Wales), Canada, Czech Republic, Estonia, Finland, France, Germany, Hong Kong, Hungary, Ireland, Japan, Korea, Netherlands, New Zealand, Russia, Singapore, Spain, Sweden, Taiwan, USA, England, Scotland, Wales, Northern Ireland

Key stage	*Example of key stages in curriculum mapping*		
	Bergeron (2015)	**Greatorex et al. (2011)**	**Hodgen et al. (2010b)**
Key features of comparison	Structure Content Cognitive demand Philosophical underpinnings University recognition	Learning Knowledge Qualification system Summative assessment task	The extent to which Mathematics is compulsory in general and vocational education The level of Mathematics available in general education How advanced Mathematics choices are structured in general education Participation rate in studying (Advanced) Mathematics
Data	Documents about all curricula which specify subject content International studies such as Trends in International Mathematics and Science Study (TIMSS)[6] Admission requirements from universities Textbooks and course outlines used by top global universities	Qualification specifications	International studies such as International Review of Curriculum and Assessment (INCA)[7], Eurydice[8] and TIMSS Documented statement of the content and teachers' role in teaching and learning Websites of ministries of education
Judges	International education consultants	Subject experts	Researchers Expert for each country
Visualisation	Tables	Tables	Tables with colour coding

[6] For further details see Mullis, Martin, Foy, and Hooper (2016)
[7] INCA was a review of curriculum and assessment around the world which ended in 2012 (Sargent et al., 2012)
[8] Eurydice is part of the European Commission which publishes comparative reports about European education systems (European Commission/EACEA/Eurydice, 2017)

6. Limitations

There are several limitations when using the curriculum mapping method. Firstly, studies are constrained to the codified curricula, which may differ from the enacted curricula (Elliott, 2014). In addition, comparisons based on documentary analysis are limited, as they do not take into account the national and cultural values, as well as the political and economic contexts in which education is often embedded (Hodgen et al., 2013a).

Secondly, documented evidence varies in quality, detail, consistency, availability, and suitability for any given study. Regarding consistency, different organisations collect and present information and data in different ways (Bergeron, 2015; Hodgen et al., 2013a; Hodgen et al., 2010b). The level of detail and vagueness of data varies which influences the usability of data (Darlington, 2017; Elliott, 2014). When such differences arise, the validity of the comparisons can be undermined, unless mitigating measures are taken. For instance, content-based subjects often lend themselves to curriculum mapping more readily than skills-based subjects. This is because the specifications associated with skills-based subjects tend to be less detailed than the specifications for content-based subjects. Therefore, one approach is to use the skills-based specifications as well as the assessments (examination question papers, mark schemes, and equivalent) as data.

Thirdly, data may be recorded in languages other than those used by the researchers. If funding for translations is unavailable then curriculum mapping is restricted to data recorded in the researchers' language(s) or translations using free automated software. The quality of studies is mediated by the quality and fitness for purpose of the translation(s) used (Elliott, 2014).

Finally, curriculum mapping gives a representation of relationships between aspects of curricula but does not identify causal relationships (English, 1978; Hodgen et al., 2013a). For instance, a curriculum mapping may include participation rates and attainment levels, but does not give evidence of the effect on, or relationship to, attainment level. There may be many additional variables which influence how this curriculum is enacted and experienced.

7. Benefits

The key benefit of curriculum mapping is that focused comparisons of curricula can be made (Elliott, 2014; Greatorex et al., 2011). Also, mapping of new and older curricula allows immediate comparisons enabling swift evidence-based action to be taken (Greatorex et al., 2011). In contrast, comparability studies using candidates' performance and or progression to jobs and further stages of education can only take place after curricula has been in practice for a significant period of time, or after at least one cohort of students has completed the qualification(s). This may result in problems or shortcomings taking longer to identify.

8. Uses

Curriculum maps are frequently used to aid understandings of curricula and as a tool for curriculum review, improvement, or development. It is important to note that generally

curriculum mapping cannot indicate what individual students can and cannot do, because the comparison is about the curricula and not qualification results.

In summary, curriculum mapping can be used only to make decisions about the codified curriculum, and not the enacted or experienced curriculum. In other words, findings from curriculum mapping studies are confined to findings related to the contents of curriculum documents.

9. Conclusion

A curriculum map is a visual representation of aspects of documented curricula. This method involves comparing documented curricula using the 'curriculum map' tool to collate data, which can then be used to summarise the results of the study. This method is widely used to compare curricula for a variety of purposes, and to answer an array of research questions. This article will hopefully contribute to the current gaps in methodological literature to support researchers in using this method.

The six-stage guide offered in this article can serve as a model of good practice of how to employ the curriculum mapping method. Using and building on this guide will allow researchers in education to increase the transparency, rigour, and applicability of curriculum mapping work in the future.

10. Notes

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