The Integration of Research in the Higher Education Curriculum: A Systematic Review

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Abstract

The support for connections between research and education is widespread. This connection yields the promise of educating students for the knowledge society. With the curriculum as the most important carrier of planned higher education, the lack of systematic insight in how research can be integrated into the curriculum is an important omission. This systematic review considers how empirical studies provide input for the integration of research in the higher education curriculum. Moreover, it provides a structured insight into the current body of knowledge on research in the curriculum. Based on a first set of 5815 journal articles, 121 articles were selected for further analysis. The model of Curriculum Aspects by Van den

Akker (2003) was used to categorise the articles, which shows a body of knowledge on research in the curriculum with the largest focus on learning aims and learning activities. Furthermore, this review shows how few studies consider the effects of curriculum design on student learning, which calls for more empirical studies to benefit student learning.

Contents

Introduction

The connection between education and research yields the promise of sufficiently educating students as future professionals for the knowledge society (Barnett, 2012; Healey & Jenkins, 2015). The importance and necessity of this connection is embraced at all levels of formal decision making: By the European Committee (2017), among national policy makers (Ministry of Education, 2015), in institutional policies (Hogeschool van Amsterdam, 2015) and in higher education quality-enhancement systems (NVAO, 2017). This importance is related to the fundamental function of higher education, which supposes that higher education students are transformed through their interaction with systematic knowledge and research (Ashwin, 2014).

Whilst the notion of a connection between research and education has widespread support, the connection itself has as many faces as it has supporters (Trowler & Wareham, 2008). Previous studies have shown connections between research and education at the policy level (Griffioen, Ashwin, & Scholkmann, submitted), in the organisational structure of universities (Jenkins & Healey, 2005) and in the activities of administrators (Neumann, 1993), academics (Åkerlind, 2008) or students (Griffioen, 2018). Moreover, these connections have been shown to be mostly normative or descriptive in nature (Trowler & Wareham, 2008).

So far, the curriculum has been underrepresented as a studied location of the connection between research and education, even in studies considering these connections (Trowler & Wareham, 2008). Studying the design and effects of curricula is a complex endeavour, but it is also an important one, as the curriculum has been shown to be an important carrier in the transmission of knowledge from one generation to the next (Young, 2014).

Barnett (2009) has stated that designing a curriculum—in the end—comes down to answering two crude questions: 'What should we teach?' and 'how should we teach?' With these two questions, a pedagogic vehicle is created that invokes the epistemic activity of learning through encounter with knowledge. With learning as an epistemic or knowledge-producing activity (Scott, 2014) and research as an identity changing vehicle, it is very important to understand how we can design research in the curriculum. Deep encounters with knowledge can bring changed epistemic values. Processes of acquiring knowledge and coming to understandings through a full educational curriculum can provide this deep encounter and bring about these changes in students (Barnett, 2009).

Hence, the curriculum is an important carrier of planned education and can be defined at the module level, programme level, national level, or through planned learner–teacher interactions (Bovill, 2014; Fraser & Bosanquet, 2006). Curricula are generally the result of a process of defining educational goals and are considered the way to achieve these goals in students (Roberts, 2015). While the curriculum combines the function of learning enabler with the constraint of the same learning, it is also a generic carrier, as no particular model of pedagogy or similar set of

presumptions are implied (Young, 2014). Every curriculum includes specific pedagogical structures and its own aims and presumptions (Young, 2014), although they do combine and align choices for learning outcomes and for teaching, learning and assessment activities (Roberts, 2015). One can presume that actively including research into the curriculum requires additional curriculum design expertise, building on specific subject matter knowledge, pedagogical content knowledge and curriculum consistency expertise (Huizinga, 2014).

There are many perspectives and definitions of research. For this article we use the inclusive Frascati definition of research: 'creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of humanity culture and society, and the use of this stock of knowledge to devise new applications' (Blackmore, 2018; OECD, 2015).This definition does not limit the way this notion of 'research' plays a role in higher education curricula design, which is the object of this study, or how research is conceived by different disciplines.

Previous studies have considered student roles on the module level (Healey, 2005) and proposed to apply these to the curriculum level, but so far, there has been no overview of empirical studies considering research in the curriculum. Considering societal dependency on the higher education system for the production of future knowledgeable, employable professionals (Griffioen, 2018), this is, at the least, surprising.

The current study aims to provide a systematic insight into the existing body of knowledge on research in the curriculum through a systematic literature review. This review will aid in gaining insight how research is positioned in contemporary literature. It will also provide a more comprehensive knowledge base on curriculum design. The central question answered in this study is: How is research, positioned in higher education curricula, described within higher education empirical literature? Answering this question will provide an overview of the existing body of knowledge regarding research in the curriculum.

Article Selection and Inclusion

A comprehensive and public list of higher education journals (ECHER, 2017) was used as a starting point to reach a selection of relevant search engines. All databases that provide access to these journals were included in the initial list of publishers' search engines, which included: Elsevier, Springer, Wiley, Sage, Jstor and Taylor & Francis.

The search engines were used to find articles using the keywords: High* OR university* AND research AND curricul* as part of the title or abstract. For all search engines, the following inclusion criteria were applied: Search within the full text of the article; full text available; published since 2000; academic journals as a search type; written in English; concerning university- higher vocational or further education. All education levels were included. Articles not concerning the curriculum, as well as articles mentioning 'research' not as part of a described curriculum were excluded.

Each of the search engines provided different technical search options, so we adjusted the actual search steps to their technical possibilities. The second step consisted of a manual selection of articles, which was based on the reading of the title and abstract of all articles. This was done in order to only include articles that focussed on research in the curriculum in a higher educational setting. If the title and abstract did not provide sufficient information, the article was read in full. The initial selection of articles was done by two researchers, who needed to agree on inclusion. This step also corrected several false-positive results, due to authors or articles using the term 'research' to stipulate their own research presented in the article while not using 'research' as a topic of study.

Characteristics of The Data Set

The initial search resulted in 5815 initial matches across all search engines. Manual selection by two researchers resulted in 121 included articles that address research related to the curriculum in a higher education context. For the initial matches and the included number of articles per search engine, see Table 1.

Table 1: Search Engines Included in Systematic Literature Review.

Search Engine	Initial number of articles	Relevant number of articles
Elsevier	1743	38
Springer	1731	12
Wiley	965	43
Sage	729	5
Jstor	413	8

Taylor & Francis	234	15
Total	**5815**	**121**

The findings show that most of the included studies discuss curriculum aspects of Medical Education (17%), Nursing (11%) and Chemistry (7%), therefore providing a larger knowledge base for disciplines related to the wider natural sciences. The largest knowledge bases related to social sciences were for Psychology (4%) and Social work (4%). Overall, most studies discuss curriculum aspects related to undergraduate education (45%), while other studies consider graduate education (7%), education for (medical) residents (10%) or a combination of educational levels (7%). Half of the studies originate from the USA (50%), followed by Australia (10%), the UK (8%) and smaller providers such as the Netherlands (3%) and Canada (2%). A small number of studies discuss curriculum aspects in multiple countries (4%).

Data Analysis

The process of data analysis consisted of a systematic categorization process for the selected articles. This was done by applying the curriculum categorization proposed by Van den Akker (2003). This is a comprehensive model for curriculum design, which is intuitively logical for curriculum designers (see also http://international.slo.nl/intcoop/). The model includes the curriculum aspects: Rationale (Why are they learning?), Aims and objectives (Towards which goals are they learning?), Content (What are they learning?), Learning activities (How are they learning?), Teacher role (How is the teacher facilitating the learning), Materials and resources (With what are they learning?), Grouping (With whom are they learning?), Location (Where are they learning?), Time (When are they learning?) and Assessment (How is their learning assessed?).

Three researchers individually categorized the articles by applying the ten curriculum aspects described by Van den Akkers (2003). For an overview of all articles per curriculum aspect see Appendix 1. In almost all cases articles only applied one curriculum aspect as their focus of study, only including other of the ten curriculum aspects to describe the setting of the study. We categorized the articles based on this focus of study. Only one article included intended to give a more holistic conceptual model of all curriculum aspects. This article was examined separately in the findings.

The few categorization disagreements (five articles) were discussed among the researchers until agreement was reached. After categorization, all articles were qualitatively described to provide insight into the body of knowledge of each curriculum aspect and presented in the findings section.

Findings

The database of 121 articles on research in the curriculum shows that previous studies do not address all ten curriculum aspects with equal importance. Most articles focus on the curriculum aspects Aims and Objectives or Learning Activities. Most other curriculum aspects are addressed in a few journal articles, while no articles with a focus on research in the curriculum related to assessment were found. Additional to the ten curriculum aspects, one article was found that has a deliberate focus on all curriculum aspects. Hereafter, the qualitative findings per curriculum aspect are presented. Table 2 provides an overview of frequencies per curriculum aspect.

Table 2: Overview of Research in Curriculum Aspects

	Curriculum Aspect	Freq	%	Subtheme
1	**Rationale** *Why do students learn?*	7	6	Defined on the level of a single curriculum (micro) Defined as part of a national curriculum (macro) Defined as disciplinary guidelines (macro)
2	**Aims and Objectives** *To what end do they learn?*	46	39	Research for professionals Driver to educate better professionals Evidence-based practice Research increases the quality of actions Procedure to solve problems Leads to better innovations, interventions or actions To make research-based decisions
3	**Content** *What do they learn?*	2	2	Research ethics
				Research-led

4	**Learning Activities** *How do they learn?*	48	40	Lectures Lectures combined with other didactics Research-tutored Deep reading Literature Study Research-oriented Workshops Laboratory- based workshops Hybrids of online and live Research-based Students as research assistants Field research for academic or professional assignments Students attending conferences
5	**Teacher Role** *Who facilitates learning?*	4	3	Staff as supervisors Teaching assistants Institutional researchers supervising undergraduate education University librarian supervising undergraduate education Staff as teachers
6	**Materials and Resources** *With what do they learn?*	5	4	To learn to do research To better choose research To supervise research
7	**Grouping** *With whom do they learn?*	1	1	Graduate students and undergraduate students together
8	**Location** *Where do they learn?*	1	1	On campus studying the campus
9	**Time** *When are they learning?*	5	4	Order, sequence, integratedness Time-density
10	**Assessment** *How are they assessed?*	0	0	
	Total	121	100	

Rationale of the curriculum

The Rationale of a curriculum considers the question, ‘Why do students learn?’, which Van den Akker (2003) defined in three potential levels: On the level of the individual course, module, lesson plan or curriculum (micro); on the level of the school or multiple curricula (meso) or on the level of the country or complete discipline (macro).

Of the seven journal articles found that have their focus on the rationale of research in the curriculum, six consider the macro level. Of these six, five are related to the wider field of medical education, anatomy and pharmacy or nursing. These articles consider the importance of learning evidence-based practices that are based on research as well as through research. Most are visionary or normative in nature and state that learning research and hence evidence-based practices will improve patient care. The article by Peckover and Winterburn (2003) on Nursing bases their visionary perspective on an extensive literature review on research-in-education practices. Kiley, Moyes, and Clayton (2009) also focus on the macro level, but they examine the Australian honours education. By interviewing students and faculty, they consider the purpose of honours education, which, for the largest part, is shown to prepare and select for higher degrees in research, develop research skills, and introduce research practices.

The only study considering the micro level is provided by Brokaw and O’Loughlin (2015). They position educational research as an important activity and quality in PhD programmes for candidates entering with Anatomy and Cell Biology degrees. As a result of this programme, Brokaw and

O'Loughlinn assert, PhD's can lecture on Anatomy and are highly qualified as educational researchers.

Aims and objectives of the curriculum

The aims and objectives of a curriculum answer the question, 'To what end do they learn?' (Van den Akker, 2003). The systematic review resulted in 42 journal articles in this category. The findings show how the aims and objectives of research in the curriculum can be roughly divided into two subcategories.

In the first subcategory, research for professionals, the articles relate research as a learning aim or objective to students training into one or more specific professional fields and consists of two out of five of all articles in the whole Learning Aims & Objective category.Two different aims were found in this subcategory. A recurring aim related to professional practice was learning evidence-based practice (EBP) which was the central focus of five articles. A second more generic aim was found in eight other articles that consider research in general to be a driver to educate better professionals. Some articles in this subcategory describe research methods as a means of specifically stimulating scientific careers with academia as the future professional context. Professional development was mentioned in one article, but the majority mentioned that research skills can be used for either future employment or improved performance of current students. So while all articles in this subcategory stress the fact that students' future professions are related to actively doing research, the focus or arguments to underpin this aim differ between articles.

The second subcategory, research increases quality of actions, consists of articles that focus on research-related learning aims or objectives, as they consider learning research as a way to improve some of their students' activities. Within this subcategory, three articles propose research-related learning aims as a procedure to solve problems. Eight articles propose that learning research will lead to better innovations, interventions or actions, such as research education to increase Evidence-Based Practice of self-efficacy among Masters of social work students (Bender et al., 2014). Five of these articles described the objective of learning to make research-based decisions. For example, Ruzafa-Martínez, López-Iborra, Barranco, and Ramos-Morcillo (2016) describe Evidence-Based Practice competences as important inmaking decisions based on the best available evidence.

Articles in this subcategory present learning aims related to how to do research, but this is always presented as a means to another end, – to improve professional action or to improve the quality of actions in general. Similar to the rationale category are the articles focussed on describing learning aims and objectives, and very little attention is given to considering whether the proposed learning aims and objectives were achieved through the proposed curriculum.

Content of the curriculum

This category of the curriculum describes the actual content of what students learn. Articles in this category specifically focus on the role of research related to a specific content of education and hence describe this content more elaborately than, for instance, in the previously described category of Aims and Objectives.

Only two articles are focused on research related to the content of a specific disciplinary science course. Both articles focus on research-related aspects that are placed central in the content for students. The scientific courses described are research ethics for Radiology residents (Chertoff, Pisano & Gert, 2009), in which learning research ethics is the content-focus of the curriculum. The second article focusses on desalination information in a specific course as part of the engineering curriculum (Ettouney & El-Dessouky, 2001). In both articles, the structure of the course is elaborately described, providing a clear outline of the different course components.

Learning activities of the curriculum

The learning activities of a curriculum considers how students learn (Van den Akker, 2003). The findings in this category resonated with the four quadrants by Healey (2005) and are hereafter presented as such. These quadrants entail research-led, research-tutored, research-oriented and research–based teaching and will be further explained in the following sections.

Several articles were shown to be based on research-led learning activities, in which students have the role of an audience and the activity focuses on learning research content. Four articles were concerned with lectures about research methods; three of these articles incorporated lectures with other activities (Fernandes, 2017; Nicholson, 2011; Parker, 2013), while the last one reported on one-hour seminars covering different subjects of research methods (Arias, Peters, & Broyles, 2016). These lectures focussed, for instance, on responsible conduct in research and ethics (Fernandes, 2017) or topics such as applying the scientific method to researching or learning about placebo effects (Arias et al., 2016). The actual didactics ranged from more practical seminars as a follow-up for research work (Nicholson, 2011) to video instructions of certain concepts (Arias et al., 2016), but in all cases, students were mainly passive learners as opposed to actually participating in the research process. This means that they would learn about research and research tools as an audience, but not be active involved as researchers.

The research-tutored category is concerned with students being actively engaged in research by applying knowledge from research. One article in this subcategory was concerned with deep reading as a learning activity in a workgroup setting (Peng, 2017). Here, students received literature they

were instructed to read and discuss in workgroups, which were supervised by a staff member. Another article reported on students conducting a literature study to learn basic research tools in dietetics (Hays & Peterson, 2003), which also resonates with problem-based (Yew, Chng, & Schmidt, 2011) or inquiry-based learning (Levy & Petrulis, 2012), but from a curriculum perspective.

In research-oriented learning activities, students learn about research methods by conducting fragments of research methods. Twelve articles reported workgroups of a smaller number of students as a setting to teach research methods. The frequency of these workgroups ranged from a single lecture (Fernandes, 2017), in which the content of the entire course was explained, to weekly workgroups, in which the teaching was scaffolded to gradually teach students (Temple, Cresawn, & Monroe, 2010). It also seemed that the more seminars were provided, the more interaction between students was required and expected; or, argued the other way around, the more interaction was required, the more seminars were provided.

Two particular types of research-oriented learning activities were laboratory-based workshops and hybrid learning activities. The greatest number of laboratory-based workshops were part of STEM courses (Temple, 2010; Kreiling, 2011). For these sessions, there is usually a very clear setup, with regular contact hours for students. Several articles provided tables with exact explanations of week-to-week activities during the course. These sessions were mostly concerned with activities that can't be done outside of a lab environment, such as situations in which the lab experiments involved isolating a bacteriophage, as described by Temple et al. (2010). Articles explain how lab sessions are needed to replicate research in the lab in order to teach students how to use research tools through first-hand research experiences.

Two articles reported research-oriented learning activities in a hybrid learning environment that combined online and live education. One of these positioned online assignments into face-to-face classes (Browne-Ferrigno & McEldowney Jensen, 2012). The other gave students the opportunity to pick their own assignments from an online environment and work on these outside of the classroom (Dietz, 2006). These assignments could be practice exams or data analysis tasks. Therefore, a balance between theory and practice was integrated in these assignments.

In research-based learning activities, students are actively involved in research as (co-)researchers. There were three types of learning activities found in this subcategory. Firstly, three articles were concerned with students assisting in research being conducted by a staff member. Zimbardi and Myatt (2014), for instance, reported on five different models ranging from doing research under direct supervision to students forming and tending to their own research questions, giving them more autonomy.

Eleven articles concerned students' field research. These were mostly concerned with building up a research paper for university classes by constructing hypotheses, selecting data gathering tools, gathering actual data and reporting (Juliá & Kondrat, 2000; Khalid, 2013; Shlonsky & Stern, 2007). A few (Bootsma, Vermeulen, Van Dijk, & Schot, 2014; Gilardi & Lozza, 2009) were concerned with conducting research projects for non-academic institutions such as companies. This approach also aimed to prepare students for work outside of the academic environment. Some articles additionally mentioned students presenting at an internal conference or publishing their final paper, while one mentioned going abroad for geological research (Nicholson, 2011).

Two articles were particularly concerned with attending and presenting at conferences as student learning activities. Both these regarded internal conferences in which students could present their research papers and internships.

The findings of the Learning Activities category show that the highest frequency of Healey's (2005) four quadrants is the research-based approach, in which students actively assist or participate in research. Second-most common is the research-oriented approach, in which students learn through actively engaging in parts of research. Considering these findings, the body of knowledge provides most insight regarding students in more active roles that are related to research in the curriculum.

Teacher role in the curriculum

The teacher role related to curriculum aspects considers how lecturers are facilitating the learning. Based on the literature body found, two teacher roles related to research in the curriculum were present in the articles. These were staff as supervisors and staff as teachers. These were staff as supervisors and staff as teachers.

The first teacher role found was staff as supervisors, such as teaching assistants, librarians and institutional researchers. Luft, Kurdziel, Roehrig, and Turner (2004) consider the teaching assistants in biology, chemistry and physics who were mostly responsible for supervising and implementing laboratory work, mostly withut supervision. This is also illustrated by their explanation of the title of their article: "The title of this article, 'Growing a Garden without Water' represents the expectations and potential of GTAs in the absence of adequate support to facilitate their growth". The second journal article (Webber, 2012) considers how the universities' institutional researchers play an active role in undergraduate research by including students as research assistants. Nearly half of the institutional researchers considered the help of the students important and recommended more often including students in university research projects. The study by (Douglass & Mack, 2015) explains the development of a project in which undergraduate students were provided with one-on-one mentorship with an university librarian. Students were taught how to search, find and cite sources and were encouraged to demonstrate creativity, knowledge and wisdom while doing so.

The second subcategory, staff as teachers, consists of a single article by Krockover, Shepardson, Adams, Eichinger, and Nakhleh (2002) in which

the lecturer provides student supervision during field trips in Geology, which is part of the new constructivist teaching model in this programme.

Materials and resources in the curriculum

The materials and resources aspect of the curriculum considers tools, materials and instruments with which students can learn. Five journal articles focus on learning materials and show three different functions: To learn research, to choose to learn research or to supervise the learner. The first subcategory consists of two articles. Erlandson, Nelson, and Savenye (2010) focus on the use of educational 'multi-user virtual environments' as a means to learn research skills.

The second subcategory only consists of the article by McKechnie and McCaul (2007), who consider the options for research training of oral and maxillofacial surgery students. Their options for research training are limited, while the demands are high. This paper provides key steps in when, where and how to accomplish the research experience in the UK setting.

Finally, two articles cover the third subcategory. In this subcategory, Maxwell and Smyth (2010) consider the supervision of students doing research by using the 'research management matrix', which facilitates research student learning management and timely completions.

Grouping in the curriculum

The curriculum aspect grouping considers how students and others are grouped in order to learn, answering the question: With whom do they learn? Only the article by Horowitz and Christopher (2013) focusses on the grouping of students by considering graduate students who are paired with undergraduate students to work on their dissertation research. The undergraduates undertake hands-on research while learning about graduate school, and the graduate students learn about mentoring research while receiving the assistance that allows them to keep their dissertations moving towards completion.

Location in the curriculum

The location curriculum aspect considers where students are learning. Only one article explicitly focuses on the location for learning. The article by McCleery, Lopez, Harveson, Silvy, and Slack (2005) studies two projects in which undergraduate students research wildlife on two different university campuses in Texas, a state in the USA. The study shows how using the campus as a research location reduces time, provides the opportunity for a long-term curriculum line and raises the department's status on campus.

Time in the curriculum

The curriculum aspect time considers the question: When are they learning? The findings of this systematic review show how, related to learning research, two subcategories can be distinguished: Articles that focus on the order or sequence of learning and articles that focus on the time-density of learning.

The first three articles consider the order, sequence and integratedness in which students learn aspects of research.

Barron and Apple (2014) tested an integrated two-course sequence in which students shifted in and out of research methods against a non-integrated two-course sequence of methodology among undergraduate psychology students. Their results showed that students in the integrated track received higher initial grades and also scored higher on methodology skills on their exit assessments at the end of their undergraduate careers. Lima and Tsiang (2017) suggest that training researchers in economics should start with some first-year coursework. And then, only after a sound foundation of reading, research papers in economics classes can be added. However, they did not test their proposal. The third article, by Schweizer, Steinwascher, Moosbrugger, and Reiss (2011), considered whether three modules on methodology would result in three non-integrated perspectives of methodology in psychology undergraduate students. Their findings show how there is a division in three parts, with a second-order commonality.

The second subtheme related to the curriculum aspect time considers the time-density of learning research methods. The two studies considering time-density provided partly contradictory results. The study by Bude, Imbos, Van de Wiel, and Berger (2011) shows how condensed courses, as an effect of a reduction of course time, make it more difficult for first-year health students to reach a proper understanding of statistics; the issue here is the amount of time to spend. However, the study by Pliske, Caldwell, Calin-Jageman, and Taylor-Ritzler (2015) shows how an integrated and intensive research methods and statistics course which consists of team-based learning, authentic projects, Excel and SPSS actually is effective for psychology students. It is clear that both studies consider the issue of time- and content-density, but the effect on student learning remains contradictory.

Assessment in the curriculum

The curriculum aspect Assessment considers the assessing of learned content in students. No journals addressed the testing of research as part of the curriculum.

Combined, the body of articles provides a list of suggestions for research in curriculum design (see Table 2).

Contribution to evidence of learning effects in students

As part of the aim to provide an overview of empirical studies on research in curriculum design, we also considered the firmness of the evidence provided in this body of knowledge. Generally, the articles were prescriptive/descriptive in nature, with an intention for curriculum creation or curriculum change, which were, therefore, prescriptive or descriptive in nature (56%). Only a marginal portion of the articles consisted of an experimental testing of a curricular implementation of research (12%). These articles were mostly part of the curriculum aspect of Time. A more extensive number of articles (32%) were prescriptive/descriptive in nature, with a perception study among students related to the focus of the study such as gathering students' perceptions on honours programmes from different disciplines and different universities (Kiley et al., 2009). Whilst the intention of the last group of authors clearly is to provide some evidence to the study, based on the provided methods and data, it is shown that there is no solid evidence on whether the proposed or implemented research in the curriculum will lead to the described learning aims. For a full typology of the articles, see table 3.

Table 3: Typology Table

Study Design	Number of Articles	%
Case Study	74	61
Case series	18	15
NRCT	4	3
Quasi-Experiment	8	7
Cross-sectional / Survey	3	2
Cohort Study	3	2
Experiment	4	3
Content Analysis	1	1
Descriptive NAO	5	4
Mixed Methods	1	1
Total	**121**	**100**

Conclusion & Discussion

This systematic review aimed to investigate the scientific literature on the position of research in higher education curriculum for students' education.

The findings have shown how academic journal articles provide insight into the position of research in the curriculum: A total of 121 journal articles were found to discuss research in the curriculum in a wide number of disciplinary fields.

Keeping in mind the Van den Akker model (2003), he journal articles found mainly provide a focus on the curriculum aspects Aims & Objectives and Learning Activities, while they provided a reduced amount of insight on seven other curriculum aspects, such as rationale, content, teacher role, materials & resources, grouping, location and time. There were no articles found that specifically focussed on the curriculum aspect Assessment, while this aspect was mentioned indirectly. It is plausible that our systematic search focus on the 'curriculum' did not provide articles on assessment if assessments by curriculum designers and researchers are not considered to be part of the curriculum but are considered a separate entity when considering students' education. While this is plausible, it is also potentially troublesome, as assessments are considered to support student learning (Gibbs & Simpson, 2005) and are therefore considered to be an important part of the curriculum.

The curriculum design ideas found provide many suggestions for curriculum designers on how to implement research into the curriculum, which is summarized in Table 3. Also the full list of journal articles per curriculum aspect as provided in Appendix 1is a very rich source of ideas about innovating curricula on all higher educational levels. However, even combined, they lack solid evidence about what effects to expect fromeach of these curriculum design notions. There is, for instance, little evidence on the learning effects after implementation, because only a small number of the articles provided experimental data. The little experimental data provided was limited to aims & objectives (Bloom, 2013; Knowlton, 2013; Houghton, 2017), learning activities (Thomas, 2000; Hsieh, 2016) and materials & resources (Erlandson, 2010). The notion of lack of empirical evidence seems to be applicable to the wider field of the research–teaching nexus (see also Trowler & Wareham, 2008). The findings show how in this field of study, we are able to provide strong ideas about how to organise the connection between research and teaching in the curriculum, but as a research field, we do not yet take the effort to test the effects of our curriculum designs, beyond asking stakeholders about their perceptions and experiences. In order to consider the quality of our curriculum designs, we should be willing to consider these empirical effects as well.

Considering the possible effects of student learning through research (Ashwin, Abbas, & McLean, 2014; Scott, 2014) as a possible way to reach a deeper understanding (Barnett, 2009), it is very important to understand how we can design research in the curriculum oriented towards its learning effects. It is essential that we start to study the student-learning effects of the proposed designs on research in the curriculum, so we can design curricula more consciously. Additionally, we have found a single journal article by Brew (2013) that has started to consider research in the curriculum more holistically. However, also this study considers research in the curriculum from a proposed design perspective. As a higher education field we additionally need to consider the effects of these design options empirically.

Furthermore, where the multiple aspects where implementing research in curricula are considered, they implicitly also refer to the complex competencies lecturers and curriculum designers need when actually implementing research into a curriculum design. Generally, high quality curriculum design requires curriculum design expertise, subject matter knowledge, pedagogical content knowledge and curriculum consistency expertise of lecturers (Huizinga, 2014). So beyond the actual curriculum design options and its effects, also the prerequisites of these designs in lecturers and curriculum designers need to be considered. Only then can high quality curriculum designs result in high quality education for students.

The overview in this study suggests that systematically implementing ‘research’ in the curriculum requests additional competencies on all these aspects, because research takes different shapes as different curriculum design aspects. Teaching students research skills requests a different shape of research than teaching students another content and applying research as a didactical tool. When research is positioned as assessment tool it takes another shape again. These shapes of research in the function of student learning through the curriculum are often not part of lecturers’ basic competencies, where the presence of these competencies can help to bring the functionality of research as part of curriculum design forward (Gray et al., 2015; Griffioen, 2013).

It is time that the higher education field collectively takes responsibility to not only implement the connection of research and teaching into the curriculum, but also to systematically consider its effects on students, as well as to help lecturers gain the curriculum design competencies needed. Furthermore, it is time we take the connection between research and the curriculum seriously and strive for a systematic inclusion of research into curricula.

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