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# Scientific thinking vs. free speech: introducing the Cascade model for justifying research-based learning to faculty

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Research-based learning (RBL), promoting an enhanced research-teaching nexus, is a pedagogical approach that has been gaining ground in universities worldwide since the 1990s. What arguments could be used to convince university teachers to RBL into their teaching? In this paper, we try to provide answers by introducing the Cascade Model for justifying RBL, which links RBL to research on epistemic cognition. The model is based on a synthesis of findings from a research network on RBL in the context of higher education reforms in Germany. These findings indicate that a mere focus on teaching formats is not sufficient for the successful implementation of RBL. Rather, the research must be meaningful to those involved - students and faculty alike. The Cascade Model for justifying RBL provides meaningful perspectives on RBL by distinguishing epistemic values that faculty might accept to justify RBL. The model suggests an argumentation cascade of possible references to four epistemic values: scientific, professional, skilled, and social. In this cascade, the link between teaching and scholarly research is progressively decreasing. We applied the Cascade Model to an interview study with 40 university teachers. The model's categories could be reliably assigned to the responses, with "scientific" being the most frequently cited epistemic value. The ranking of values can be empirically substantiated. As predicted, "higher" levels of justification (i.e., closer to "scientific") correlate with more RBL teaching.

KEYWORDS

**epistemic authority, epistemic values, epistemological beliefs, free speech, mentors, research-based learning**

## 1 Introduction

Research-based learning (RBL) - or the enhanced research-teaching nexus (Tight, 2016) - is a pedagogical approach that has been gaining ground in universities worldwide since the 1990s. For example, the Boyer Commission (1998) launched undergraduate research in the USA. RBL in the form of undergraduate research has proven to be very successful in increasing student retention and academic success (Parker, 2018; Mieg and Haberstroh, 2022). According to Kuh (2008), undergraduate research, i.e., RBL in undergraduate programs, is considered a high-impact educational practice. In the USA, undergraduate research has traditionally been offered

as a co-curricular activity, e.g., as part of an Undergraduate Research Opportunities Program (Galli, 2022). However, there are also increasing efforts toward course-based undergraduate research (Buchanan and Fisher, 2022; Mieg et al., 2022). Our contribution focuses on course-based RBL, especially on integrating RBL into an existing course offering.

This paper is the conceptual synthesis and result of over 10 years of research on RBL in Germany. Our final question was: What arguments can university management use to promote RBL to their university teachers? A simple argument might be that RBL is a good introduction to research. However, this argument is likely to be effective only with teachers who place a very high value on scientific research and consider it important for their students. Another argument, going back to the American educational reformer John Dewey, is that engaging in research promotes critical thinking, which can be seen as a prerequisite for good citizenship (Dewey, 1916; Glaser, 1985). The question of which arguments are effective is not trivial today. Any research-based argument can be challenged by claims made under the right to free speech. Free speech has ancient democratic roots and is interpreted differently in Europe and the U.S. (Belavusau, 2010). The justification of knowledge and beliefs provided by free speech need not to be evidence-based, but can be derived from political or religious values (Blocher, 2019). In this context, Leiter (2022) speaks of the Internet as a new "epistemological crisis" in which it has become unclear what can be considered true.

In what follows, we present the Cascade Model for justifying RBL which organizes arguments for RBL according to the epistemic authority of the university for the argument. We can think of the university as an authority on matters of science and research. The authority of the university may diminish, for example, when it comes to social issues. Before presenting the Cascade Model in detail, we will give an introduction to RBL and our own research in this area, which led us to the insight that RBL must be meaningful not only for students but also for university teachers.

## 1.1 Promoting course-based-RBL, and the German RBL research network

Our focus on course-based RBL is due to our orientation toward Europe and the European university tradition, in particular the initiative of Wilhelm von Humboldt to introduce research-based education (German: Bildung durch Wissenschaft) in the first half of the 19th century (Deicke and Mieg, 2020). Since then, it has been standard practice in Germany to require a scientific paper for a university degree - with the exception of the old professions of medicine, law, and theology. In the wake of the many university reforms in Europe around the turn of the millennium (Corbett, 2011; Sursock and Smidt, 2010), a *German Quality Pact for Teaching* (Qualitätspakt Lehre, 2011–2020, 2 billion euros; see GWK, 2025) was introduced in Germany, which also explicitly promoted RBL (Mieg, 2019c). In the context of these teaching reforms, university managements were faced with the question of how to motivate teachers to integrate RBL in their existing teaching. According to Davis et al. (2020), institutional support is needed for faculty involvement in mentoring research. If the teaching in the bachelor program is done by professors - which is quite common in Europe -, it becomes important not only to support them but also to *convince* them of RBL.

The efforts to strengthen RBL as part of the German Quality Pact for Teaching were monitored by a RBL research network (2014–2018, in German: ForschenLernen, cf. WiHo, 2023), which covered RBL implementation at 15 universities. The general research design was to investigate how RBL course formats can have different effects on students' research competencies (see Figure 1). Empirical evidence of

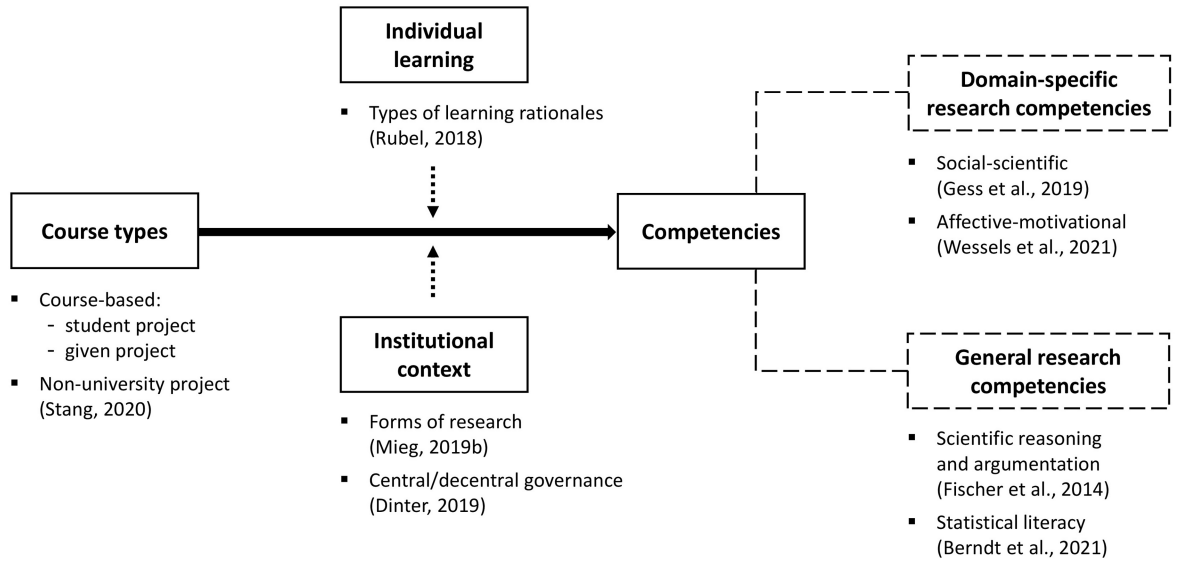


FIGURE 1
German RBL research network (ForschenLernen, cf. WiHo, 2023).

the link between RBL-oriented teaching and the development of competencies seemed be essential and useful in order to show the importance of RBL. In addition, individual learning processes of students as well as the institutional context (universities, disciplines, etc.) were investigated. Findings include:

- Stang (2020) created a typology of RBL course formats based on the variations of RBL that can be found in Germany (see Supplementary material). A major difference is, for example, whether students can define their own project with their own research questions or whether the research question is in principle predetermined by teachers.
- Gess et al. (2019) postulated a model of social science research competencies. Wessels et al. (2021) found that RBL-based courses actually promote research competency and described affective-motivational constraints (based on Wessels et al., 2018) such as self-efficacy that supports the development of research competency.
- Berndt et al. (2021) investigated more general research skills across different disciplines that can potentially be promoted with the help of RBL, in particular statistical literacy and scientific reasoning and argumentation (Fischer et al., 2014). They found (1) that statistical literacy develops depending on the discipline, and (2) that students' epistemological beliefs (i.e., the way learners think about the nature and acquisition of knowledge) affect both statistical literacy and skills in scientific reasoning and argumentation. Building on this work, a novel approach for the construction of test instruments to measure scientific reasoning and argumentation skills has been introduced (Horrer et al., 2025).
- Rubel (2018) studied types of learning rationales. She found that students can have different self-justifications for doing (or not doing) their own research: good grades, deepening knowledge, professional relevance, etc. (Table 1). These justifications may change over the course of one's studies.
- Dinter (2019) examined the institutional contexts. His study revealed that the initiation and introduction of RBL and its control could take place either centrally (by order of the university management) or decentrally (by faculty). Mieg (2019b) showed that it depends less on disciplines than on the forms of research how difficult it is for students to get started in research.

The preliminary conclusion of the RBL research network research was that *the research-teaching link must be meaningful (motivating, personally significant etc.) both for students to engage in RBL and for university teachers to teach RBL*. Firstly, with respect to students, the need for a meaningful link between teaching and research is particularly reflected by findings on student learning rationales (Table 1). Secondly, as Wessels et al. (2021) showed, students benefitted from courses that included RBL if they perceived the course to be useful for a future profession or if the mentor had a special interest in the results of student research. Student teachers are rather critical of RBL if they see no connection to their future teaching role (Thiem et al., 2020). Thirdly, a need for meaningful research is further supported by our findings that only personal research activity fosters perceived research competence of students (e.g., Epstein et al., 2023; Haberstroh and Thiem, 2023; Schmidt et al., 2021). Last but not least, personally meaningful research is also important for the motivation of doctoral students to write and complete a doctoral thesis (Redies, 2019). The need for a meaningful link of teaching to research is consistent with older similar findings by Brownell et al. (2012) or Levy and Petrulis (2012).

Although the focus of the RBL research network was on students, some projects also addressed university teachers. For example, a collection of best practices in RBL - from the perspective of teachers (Lehmann and Mieg, 2018) - revealed eight challenges: (1) attracting students to research; (2) understanding and reflecting on research; (3) providing space (physical, social, online); (4) (interdisciplinary) collaboration; (5) getting practical; (6) making it public (publishing); (7) developing teaching skills; (8) changing the university (see also Mieg and Haberstroh, 2022). A follow-up study with lecturers in Austria (Mieg, 2019a) showed that the university teachers who were seen by students as exemplary for RBL were precisely those who created additional space for their students (physical/social/online, e.g., to attend conferences; as required in point 3). According to Purrer (2024), many university teachers in medicine understand RBL as including students into their medical research projects.

TABLE 1 Types of student learning rationales for RBL (**Rubel, 2018**).

| Type of rationale | Justification (examples) | Recommendation for RBL mentors | Justifications for RBL (by mentors, for students) |
|---|---|---|---|
| Grades | Studying to advance within the given educational system | Establish student research teams that provide mutual support among students | Deep learning (with the prospect of better grades). Greater visibility with the mentor through active RBL (with the prospect of greater appreciation from the mentor). |
| Professional | Studying to be fit for a specific job / profession | Support student research projects with external professionals or firms | Modern professional work involves research; in order to understand research properly, one should have conducted research oneself. |
| Personal development | Studying to explore new knowledge / to expand one's universe | Support students' scientific interests and skills (with sufficient student autonomy) | Acquire skills in critical / scientific thinking. |

Students were asked to justify why they were involved in RBL. Justifications for RBL (by mentors, for students) have been added.

## 1.2 A Cascade model for justifying RBL

How can a university convince its faculty to support their students' RBL? Universities are historically very successful educational institutions that originated in Europe in the 11th century and have been exported worldwide since the modern research university emerged in the 19th century. Today, universities are a core epistemic authority in scientific research. Therefore, university management can claim to be the standard-bearer for research-based teaching and ask faculty to support RBL. In making this claim, universities can refer to the value of scientific research for improving our understanding of nature and society. The university could also make the social claim that, for instance, RBL can and should support local communities as part of the university's social responsibility. In this context "scientific" and "social" function like *epistemic values* (Chinn and Rinehart, 2016; Chinn et al., 2020), that is the values arguments for RBL could serve. Chinn and Rinehart (2016, p. 469) define epistemic value as the value of epistemic aims, for instance aims like "deeper understanding" (epistemic value: scientific) or "better medical treatments" (epistemic value: social).

Below, we present the Cascade Model for justifying RBL using several characteristics listed in Table 2. The model contains four epistemic values: *scientific*, *professional*, *skilled*, and *social*. These values can serve as reference points for arguments justifying RBL. Different *epistemic authorities* provide or evaluate knowledge based on epistemic value. An epistemic authority is defined, in part, by trust (Hendriks et al., 2016). Epistemic trust is placed in individuals or institutions and can be backed by political ideology, for instance (McCright et al., 2013). Our concept of epistemic authority follows the argumentation of Chinn and Rinehart (2016) and Bromme et al. (2010): that there are always epistemic authorities (who knows what) and that we receive most of our knowledge second-hand (e.g., through our studies). It is common and useful to be able to rely on the knowledge of others (Mieg, 2001). A vivid definition of an epistemic authority is given by Leiter (2022, pp. 2-3):

> Someone who tells people what they ought to believe, and in so doing, makes it much more likely that those people will believe what is true (i.e., they will believe what they ought to believe, ceteris paribus) than if they were left to their own devices in trying to figure out for themselves what they have reason to believe.

### 1.2.1 Scientific

Table 2 provides an overview of the ways to argue for RBL depending on the epistemic value. The table shows first the specific type of knowledge that is valued and aimed at with which epistemic value. Then possible arguments in support of RBL are listed. Two arguments appear for each epistemic value, first an argument with a strong claim. However, as the strong claim can easily be doubted, a second argument with a weaker claim, often based on indirect impact of RBL, follows. In case of the *scientific* claims, the strong one would be (first argument): RBL enables a deeper understanding of research and thus also deeper knowledge (Huber, 2009). The weaker claim (second argument) would be: University is defined by the strong nexus of research and teaching (von Humboldt, 2010), as realized by RBL. For both arguments a university can exert epistemic authority or *is* the epistemic authority (as an institution). The kind of valued knowledge is scientifically verified knowledge, whether it is evidence-based or supported by mathematical proof.

TABLE 2 Cascade Model for justifying RBL.

| Characteristic | Scientific | Professional | Skilled | Social |
|---|---|---|---|---|
| Type of knowledge valued | Scientific knowledge (evidence-based, proved) | Practical knowledge (highly qualified work in risk-propense fields) | Knowledge that drives individual competency development | Knowledge that is compatible with a social ideology |
| Arguments for RBL (which can be used by the university management to convince faculty) | *Value of science*: RBL enables a deeper understanding of research and thus also deeper knowledge (Huber, 2009).<br>*Research-teaching nexus*: University is defined by the strong nexus of research and teaching (von Humboldt, 2010), as realized by RBL. | *Direct impact*: RBL helps develop professional skills and attitudes ("reflective practitioner," Schön, 1983, 1987).<br>*Indirect impact*: Today's professional practice is inconceivable without the use of research results (be it medical research or market research). You can only understand research if you have done research yourself (e.g., through RBL) (Mieg, 2020) | *Specific*: Research skills (which can be acquired through RBL) are among the key competencies in our modern and complex world (González-Pérez and Ramírez-Montoya, 2022).<br>*General*: RBL enhances knowledge and skills (Kleinschmit et al., 2023). | *Direct impact*: RBL can have social benefits, e.g., as community-based or application-oriented research (Pawson et al., 2022).<br>*Indirect impact*: Critical thinking – as acquired by RBL – makes us better citizens (Dewey, 1916; Glaser, 1985). |
| Epistemic authority | University or scientific experts | Profession or professional experts | Educational institutions or educational leaders | Societal institutions (or social/political leaders) |
| Academic controllability (power of the university to implement the support of RBL) | Via institution: The university sets the internal guidelines for teaching and research | Via disciplines: Adapting to a discipline's / profession's way of teaching and research | Via pedagogy: Adapting to a systematic approach to teaching and learning | Via ideology: Adapting to politically relevant ideas and beliefs |
| Epistemic interventions (see Chinn et al., 2020) | Content-focused | Ways of knowing | Evaluating ways of knowing | Inquiries into ways of knowing |

The columns show four epistemic values that may serve as justification for RBL arguments. The epistemic authority of the university for these arguments decreases from left to right.

### 1.2.2 Professional

The second epistemic value in the Cascade Model is *professional*, referring to highly qualified work in a risk-propense field (Mieg and Evetts, 2018). The strong professional claim would be: RBL helps develop professional skills and attitudes, as in Schön's model of the "reflective practitioner" (Schön, 1983, 1987). The weaker claim would be: Today's professional practice is inconceivable without the use of research results (be it medical research or market research); you can only understand research if you have done research yourself, e.g., through RBL (Mieg, 2020). The type of knowledge professionally valued is practical, generally regulated by standards controlled by a professional association outside of the university (Mieg and Evetts, 2018). Within university, the representation of a profession is a discipline. The distinction between professions and academic disciplines has historic roots. Three of the classical four founding "faculties" of the medieval European university are the classic professions of medicine, law, and theology (Shank, 2013). With the technical universities of the 19th century, the professions of engineers and architects were added. The fourth original faculty was philosophy (which had its origins in the faculty of arts). This, in principle, was the only faculty dedicated to knowledge itself, and it is from the faculty of philosophy that the entire spectrum of today's - not purely professional - disciplines, from mathematics to ethnology, has emerged over time.

### 1.2.3 Skilled

The third epistemic value is *skilled*, referring to knowledge incorporated in skills and competency. This view is more or less directly linked to the idea of education as an investment in human capital (Becker, 1964) – an investment that can be very specific, as in the case of experts (Mieg, 2001), or more general, the case of transferable skills and key competencies (European Commission, 2016) such as digital literacy (Mieg et al., 2024) or critical online reasoning skills (Molerov et al., 2020). At the political level, in the European Union, this value has been anchored in concepts such as lifelong learning, aiming "to enable each of us, without exception, to develop all our talents to the full and to realize our creative potential, including responsibility for our own lives and achievement of our personal aims" (Delors et al., 1996, p. 17). As Table 2 shows, a RBL argument with a strong claim would be: Competency in research (which can be acquired through RBL) is one of the key competencies in our modern and complex world (González-Pérez and Ramírez-Montoya, 2022). A weaker claim would be: RBL enhances knowledge and skills (Kleinschmit et al., 2023). For the universities, arguments referring to individual skills carry the risk that other educational institutions or charismatic educators such as Maria Montessori can be seen as equally good or more competent in educating relevant skills, e.g., in terms of social empathy or leadership capability.

### 1.2.4 Social

The fourth epistemic value is *social*, that is the principled epistemic primacy of the social. In other words, knowledge is relevant as far as it serves society. The orientation of knowledge and its education to a specific set of social values can be called ideological (i.e., related to politically relevant ideas and corresponding beliefs and sets of values). Historically, there have been several ideologies of education that subsume university education, e.g., Marxist, nationalist, or religious. A RBL argument with a strong claim would be: RBL can have social benefits, e.g., as community-based or application-oriented research (Pawson et al., 2022). A common argument for RBL and undergraduate research with a weaker claim goes via critical thinking: Critical thinking - as acquired by RBL - makes us better citizens through critical thinking (Dewey, 1916; Glaser, 1985). Actually, there is broad evidence that we can educate critical thinking at universities (Abrami et al., 2015). However, there seems to be little scientific evidence that critical thinking really makes us better citizens. For the universities, any society-oriented argumentation carries the risk of being confronted with epistemic authorities that subscribe to specific ideologies, religious or political. Currently, there is a "post-truth discourse" (Lewandowsky et al., 2017), bringing forward counterevidence against research on climate change or vaccination. Lewandowsky et al. (2017) claim that this is not misinformation, but "an alternative epistemology that does not conform to conventional standards of evidence reporting" (p. 356). Thus, the knowledge that is valued from a social perspective has to be compatible with a particular social ideology that may appreciate scientific standards of evidence-finding or not.

### 1.2.5 Academic controllability

The Cascade Model for justifying RBL describes belief systems. Academic controllability means that the university has epistemic authority over the beliefs involved. In particular, academic controllability refers to the power that the university has to implement the support of RBL. Academic controllability is highest when the university can set the teaching standards itself. Controllability decreases when the university is dependent on the specific cooperation of the disciplines. In Europe, strong professions such as medicine or law have traditionally had a strong influence on education through their disciplines or faculties at universities. However, arguments that refer to the university and to professions as epistemic authorities both belong, so to speak, to the realm of the university and can therefore be controlled by the university to a certain extent. In areas beyond academic and professional education, the university loses to the extent that its epistemic authority declines. Our assumption is that the university is more academically controllable over the claim to skilled knowledge than it is over social claims. The training of skills can be anchored in curricula. However, the university has limited control over social and democratic claims. Anyone claiming freedom of speech can completely challenge academic control. According to the Cascade Model, free speech is clearly a "social" epistemic value.

### 1.2.6 The argumentation cascade

The Cascade Model for justifying RBL imples a simple cascade approach for the argumentation of the question "Why integrate RBL in your teaching?" Start with scientific research as the core reference and the epistemic authority of the university. If this is not convincing, use the professional claim, then the claim of skilled knowledge, and then the social claim. This sequence goes hand in hand with a decreasing academic controllability by the university. We speak of a "cascade" model because the original argument of the link between research and teaching, which can be used to argue in favor of RBL, is broadened and at the same time diluted by a reference to additional values such as skilled or social.

### 1.2.7 Epistemic interventions

To link the Cascade Model to the broader context of research on epistemic cognition, Table 2 lists possible epistemic interventions. As

mentioned above, we found that epistemic cognition in general and *epistemological beliefs* in particular play a role in RBL (Berndt et al., 2021). Epistemological beliefs, commonly defined as "beliefs about the nature of knowledge and knowing" (Conley et al., 2004, p. 187), influence students' learning processes (e.g., Bromme et al., 2008), in particular they affect critical thinking (Muis et al., 2021). A key finding is the transition from "absolutism" (science as facts) to "multiplism" (different legitimate views of knowledge) and to "evaluativism" (focus on the process and evaluation of knowledge) that guides the understanding of research by students (Klopp et al., 2023; Kuhn and Weinstock, 2002). There is only scarce research on epistemic cognition or epistemological beliefs of university teachers (e.g., Mataka et al., 2019). The epistemic interventions listed in Table 2 refer to the Apt-AIR framework by Chinn et al. (2020). These interventions are designed to help students perform fully apt "in a world with deep epistemic disagreements" (p. 171), e.g., in "post-truth" discussions about climate change or vaccination. We relate these interventions to discussions with university teachers about why they should support RBL (labeled as by Chinn et al., 2020):

- *Content-focused*: In case a university teacher seems to accept university as an epistemic authority it may suffice just to have a purely research-oriented discussion. RBL-related intervention: Explain RBL and its role in higher education.
- *Ways of knowing*: In case university teachers seem to prefer their profession as epistemic authority it may be necessary to clarify interprofessional and thus interdisciplinary knowledge discrepancies. RBL-related intervention: Discuss the notion of research in that particular discipline (see Mieg, 2019b) as well as its role in professional practice (e.g., Schön, 1987).
- *Evaluating ways of knowing*: In the case of epistemic disagreements with a university teacher that go beyond disciplinary differences, the next level of intervention might be to shift the discussion to finding reasons for different ways of knowing. RBL-related intervention: Focus on assumptions about teaching (and students). In cases where issues of justice are at stake, such as for underserved minority students, it may be useful to emphasize that RBL can promote both students' careers and their inclusion (Mieg and Haberstroh, 2022).
- *Inquiries into ways of knowing*: The last level of intervention would be to conduct one's own research. If we relate this directly to university teachers, this could mean conducting classroom research on one's own teaching (as in Scholarship of Teaching and Learning, see, e.g., Charlevoix, 2008).

## 1.3 Research questions

We applied the Cascade Model for justifying RBL in the context of a qualitative interview study with university teachers in order to answer the following three research questions:

> RQA: Can we identify the four theoretically assumed epistemic values for justifications of RBL in interviews with university teachers?
>
> RQB: Do we find evidence for the ranking of epistemic values implied by the Cascade Model for justifying RBL?
>
> RQC: Do differences in justifications correlate with teachers actively implementing RBL?

Since Davis et al. (2020) were able to demonstrate the importance of institutional support for faculty willingness to mentor undergraduate research, we are also interested in specific feedback from the interviewed university teachers regarding institutional support for RBL.

# 2 Materials and methods

We analyzed interviews conducted with university teachers about the research orientation of their teaching and their support of student research activities.

## 2.1 Case

40 university teachers from the fields of medicine, psychology, and education at LMU Munich in Germany were interviewed. The interviews were conducted as part of a doctoral dissertation in medicine (Purrer, 2024). Medicine is a classic professional training program. Psychology and education are among the many research-based disciplines that have evolved from the medieval faculty of philosophy. The LMU has been one of the top three research universities in Germany for many years and has over 50,000 students in 18 faculties. As part of the Quality Pact for Teaching, the LMU implemented a program for "research-oriented teaching" ("forschungsorientierte Lehre"), an umbrella term for an intensified research-teaching nexus. The specific goal was to get young students interested and involved in research at an early stage in higher education and to lay the foundation for an academic career or for an academic activity as part of their professional development (Huber, 2021). The programs also included extracurricular research opportunities, as is common in undergraduate research. For the sake of clarity, we will translate "research-oriented teaching" as RBL in the following.

## 2.2 General procedure

*Sample*: University teachers from the two departments of Medicine (23 participants) and Psychology & Education (17 participants) were interviewed. The age range was 27 to 81 years. The interviewees were recruited via a contact email in the two departments. Additional interviewees were specifically approached using snowball sampling in order to achieve as broad a selection of university teachers as possible (in terms of age, sub-disciplines, types of courses, etc.).

*Interviews*: Structured interviews were conducted (see Appendix A for the interview guide). The interviews generally lasted around 15 min (range: 5–30 min). They were conducted by a total of three members of staff. All interviews were transcribed.

*Coding*: The responses were subsequently coded and classified (see 2.3.1).

*Analysis*: We analyzed the resulting data nonparametrically. We used binomial tests for the probability of success, Kendall's tau for

interrater reliability, Spearman's rho for correlations, and Fisher's exact test for data distribution when testing the research questions.

## 2.3 Variables

### 2.3.1 Epistemic value

This variable is nominal and has four values: scientific, professional, skilled, and social. The scoring was based on the answers to the interview question: "Do you see any added value in research-based learning, and if so, what is it?" (see Appendix A).

We assumed that some respondents would make a significant reference to an epistemic value in order to be able to answer the question about added value, e.g., "from the doctor's point of view" (epistemic value: professional) or "if we want to teach research methods at the university" (epistemic value: scientific) etc. Examples from the interviews:

- *Scientific*: Because it is a scientific institution, research is clearly part of it. I also think that it does not matter what you teach. Even if you are training teachers who are supposed to work in a practical setting, I think that a certain degree of science simply has to be present (Interview 40, Psychology & Education Department, translated)
- *Professional*: If you want to be a doctor, you have to understand whether it is basic research or clinical research that forms the basis of all our knowledge, which is constantly changing and needs to be adapted and critically questioned. And that's why, if you do not understand that as a student or even as a doctor, you really have no place in the field, it has to be said (Interview 13, Medical Department, translated)
- *Skilled*: I believe the added value lies in the fact that the arguments become stronger. In other words, you can build your own opinion on a solid foundation, you can engage with the results, you have to constantly question yourself, and as a result, your own convictions are continually refined and strengthened, and you can of course also persuade other groups of people (Interview 31, Psychology & Education Department, translated)
- *Social*: So it's important to emancipate yourself from this self-imposed immaturity, from simply doing things the way they have always been done, and instead to break new ground, to take an evidence-based approach, in other words, to extend the scientific approach that you are used to in your everyday professional life to your herd as well (Interview 6, Medical Department, translated)

#### 2.3.1.1 Coding procedure

There were two coding teams, the team of study authors (AP, HM), who developed the coding instructions, and a team of colleagues (AH, JZ), who carried out control coding on this basis. The coding instructions (see Appendix B) included the instruction to select the first clearly identifiable epistemic value. If no epistemic value was identifiable, the response was considered unattributed. In case of ambiguity, two classification suggestions could be made (e.g., scientific or skilled). Each team produced a consolidated list of responses assigned to epistemic values.

### 2.3.2 Implementation of RBL in courses

This dichotomous variable has the two values: yes (RBL is implemented) and no (RBL is not implemented). The scoring was based on the answers to the interview question: "Do you implement research-based learning in your courses? In particular, do students conduct their own research as part of your courses?"

*Psychology & Education*: When respondents made it clear that they allow students to conduct their own research activities in the regular course, RBL had the value "yes." Otherwise, "no."

*Medicine*: The reformed medical curriculum at the LMU includes a 12-week compulsory scientific project that each student must pursue individually (similar to the research thesis in Bachelor's programs such as psychology or biology). In addition, the medical curriculum at LMU Munich and throughout Germany follows a national regulation with little room for RBL activities in the required courses. However, some medical faculty reported efforts to support students' research activities in other ways, such as through problem-based learning or offering voluntary research internships. If respondents implemented more than one of the four RBL substitutes in their courses (i.e., problem-based learning; support for doctoral studies; evidence-based learning; "feedback through evaluation" to support active learning), RBL had a value of "yes." Otherwise, "no."

# 3 Results

## 3.1 RQA: Can we identify the four theoretically assumed epistemic values for justifications of RBL in interviews with university teachers?

Yes, Figure 2 shows the procedure and result of the coding process. 24 of the 40 justifications were clearly assigned an epistemic value by both teams. In 12 of the 16 remaining justifications, there remained a simple uncertainty, i.e., there was no agreement within one team (resulting in two coding suggestions), and in one case there was uncertainty twice (in each team). In three cases, at least one of the coders stated that an assignment was impossible and did not make a suggestion. Of the 24 clearly coded cases, there were 16 matches between the two teams ($p < 0.01$, binomial test with a success probability of 0.25). Adding up all cases, there were 26 matches (65%). This is also a significant result above chance ($p < 0.01$, binomial test with an average success probability of less than 0.4).

### 3.1.1 Interrater reliability

We can also calculate interrater reliability across all codes. To do this, we use the implicit ranking of epistemic values in the Cascade model and set: scientific = 4, professional = 3, skilled = 2, social = 1. The values reflect distances between the codes: "scientific" is therefore further away from "skilled" than "professional." Differences in coding are more substantial depending on the distances. If there was uncertainty within a coding team and two codes were proposed, the mean value is taken for their codes. The interrater reliability of two teams, measured with Kendall's tau, is 0.645 ($p < 0.01$). This can be considered a *very good* value. Even if there was not always complete agreement, the codings are close together.

### 3.1.2 Low number of references to "professional"

Table 3 shows the distribution of matched codings according to epistemic value. The low number of references to "professional" (only 4 out of 26) is somewhat surprising, considering how important the

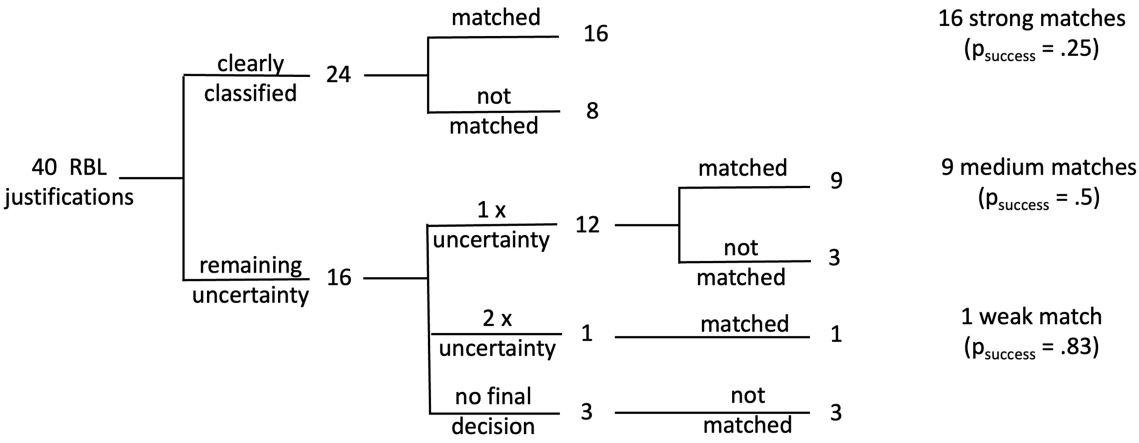


FIGURE 2
Coding procedure (two teams).

reference to the profession seems to be, at least for many students. The result becomes somewhat more relative when we look at the categorizations by the two teams before integration (Table 3, last row). Then "professional" has the second most mentions (25), only "scientific" has more (35). In our interview context, however, "professional" does not seem to provide an easily assignable epistemic value.

## 3.2 RQB: Do we find evidence for the ranking of epistemic values implied by the Cascade model for justifying RBL?

Yes, when we correlate the two team codings (as for Kendall's tau), we obtain a high correlation of over 0.70 (Spearman's rho = 0.757, $p < 0.01$). This means that the codings of the two teams are moving in the same direction. This confirms that there is an internal ranking among the coded epistemic values.

## 3.3 RQC: Do differences in justifications correlate with teachers actively implementing RBL?

Table 3 shows all cases with a match in coding and the distribution across epistemic values, as well as how often RBL teaching is implemented. We see that only 9 of 26 interviewees (35%) actively support RBL. It is striking that none of the interviewees who argue with the "skilled" value implement RBL (0). However, the absolute numbers in the table are too small to perform conclusive tests.

### 3.3.1 Correlation between epistemic values and RBL

In order to perform the calculation, we must also include the values for justifications with ambiguous coding (no matches). To do this, we create a new variable with a simple ranking of the epistemic values as "up" and "down." If the categorizations from both teams are "professional" or "scientific," then this should mean "up" (the new variable is assigned the value 3). If both categorizations are "skilled" or "social," then "down" (the new variable is assigned the value 1). If the categorizations of the two teams would intersect, i.e., sometimes "up" and sometimes "down," then they fall into a category called "middle" (the new variable is assigned the value 2). This proxy variable turns the four categories of the Cascade Model into three (up, middle, down), which run in the same direction as the ranking in the Cascade Model. The proxy variable correlates significantly with implementing RBL (Spearman's rho = 0.286, $p < 0.05$). *In other words, the "higher" the epistemic value, the more likely RBL seems to be implemented*. The effect is there, albeit very weak.

### 3.3.2 "Skilled" as an epistemic value and RBL

If we consider all codings (mean values of all categorizations for a case)[1], we can expand the group of cases with "skilled" justification from 6 to 8. RBL is not supported in a single case. This is statistically significant (8 "skilled" cases vs. all other 32 cases, Fisher's exact test, $p < 0.05$). This finding contradicts the common practice of trying to promote RBL by referring to the acquisition of necessary skills (with "skilled" as epistemic value), including our own rationale for the RBL research network (Figure 1).

### 3.3.3 Disciplines

We should also note that there were differences between disciplines, and that the RBL measure was already a compromise. In the narrow sense - truly independent student research - RBL was only supported in Psychology & Education. In Medicine we find approximate forms of RBL, e.g., problem-based learning. Interestingly,

1 In general, calculating the overall mean value of the categorizations is not helpful in our case. Many categorizations that have already been decided are then diluted, and 13 out of 40 codings fall between two categories. There is also only a weak, insignificant correlation with the implementation of RBL (Spearman's rho = 0.192). However, the distribution of RBL for "skilled" in Table 3 is only marginally significant (Fisher's exact test, $p < 0.1$). The sample size is too small to perform a meaningful test in this case. Therefore, we expanded the "skilled" group.

TABLE 3 Epistemic values for "Do you see any added value in research-based learning, and if so, what is it?" (for all cases with any match, strong, medium or weak, see Figure 2).

| (Sub-)Sample | Scientific | Professional | Skilled | Social | Total |
|---|---|---|---|---|---|
| RBL yes | 5 | 2 | 0 | 2 | 9 (13)[a] |
| RBL no | 7 | 2 | 6 | 2 | 17 (27)[a] |
| Total | 12 (8; 4)[b] | 4 (2;2)[b] | 6 (2; 4)[b] | 4 (3; 1)[b] | 26 (40)[a] |
| All classifications (both teams, before integration) | 35 | 25 | 22 | 12 | 94[c] |

[a]in brackets the numbers for all interviews; in total 40 interviews: 23 from Medicine; 17 from Psychology & Education.
[b]in brackets the numbers per disciplines (Medicine; Psychology & Education).
[c]the minimum of this figure is 80 (2 coding teams, 40 entries for 40 interviews), the maximum 160 (2 entries per team and interview). 94 means that for 14 cases, a coding team provided two possible categories.

only one interviewee from medicine linked RBL to the aforementioned 12-week mandatory scientific project at LMU Munich Medicine.

## 3.4 Institutional didactic support

The results for our research questions may depend on differences in institutional didactic support. Participants in the interview study were asked about the support they receive from the university. In fact, almost all respondents felt that there was a great deal of support available. However, whether and how this support is used varies greatly from discipline to discipline.

Almost half of the medical faculty respondents feel they receive good didactic support and take advantage of a wide range of opportunities, from tutoring programs, an intensive seminar on teaching, and a faculty development course, to the offer of an additional Master's in Medical Education. One example:

> I was primarily encouraged by my faculty to apply innovative teaching concepts, I was able to do a postgraduate master's degree in medical education with the support of my faculty and I was supported by the faculty in doing research in the field of medical education. (Interview 2, Medical Department, translated)

But there were also critical voices among medical faculty respondents, for example:

> One particular obstacle for us now is that, in my view, it [teaching] is simply given far too little importance. The value of the teaching is simply too low. (Interview 16, Medical Department, translated)

University teachers from Psychology & Education were more likely than their medical counterparts to emphasize that, despite what is offered, they tend to feel left alone and have to do the didactics themselves. Four out of 17 respondents emphasized that they value the freedom to define their own teaching. A typical answer was:

> I mean, you have to create that [didactical support] for yourself. You cannot say you have to… So you are encouraged by working well with other colleagues and forming superordinate teams and so on. (Interview 38, Psychology & Education Department, translated)

Differences in institutional didactic support have only a slight effect, if any, on support for RBL. Eight out of 23 medical respondents (35%) implement RBL, as do five out of 17 Psychology & Education respondents (29%). However, due to methodological and statistical reasons, this difference is negligible.

# 4 Discussion

The findings in the RBL research network revealed that research in the context of RBL must be meaningful (i.e., personally significant) for both students and university teachers. It was clear to us that the meaning of research also depends on the beliefs that students and teachers have about science and the university (cf. Berndt et al., 2021; Mieg, 2019a). The RBL research network had set out to prove that RBL promotes (key) competencies. Recognizing that this evidence alone may not convince everyone, we developed the Cascade Model for justifying RBL and tested it in an interview study. As far as possible with the available data, the structure of the Cascade Model for justifying RBL could be confirmed. The four epistemic values could be clearly assigned in over 60% of cases, with very high interrater reliability overall. These results confirmed the tiered structure of the Cascade Model. Additionally, it was possible to demonstrate that higher levels (scientific and professional) correlate with more RBL teaching.

The primary aim of our paper was to introduce the Cascade Model for justifying RBL. This does not yet constitute empirical proof of its effectiveness. The Cascade Model would offer *university management* simple yet significant advice. Promote RBL specifically among faculty by arguing on the basis of scientific or professional epistemic value. This can refer to the unity of teaching and research or the qualifications and scientific support of professional work. In most cases, consider different disciplinary understandings of research (Mieg, 2019b). However, be careful with arguments based on social necessities (e.g., ecological transformation, free speech, religious beliefs, etc.) because universities do not have sole epistemic authority over this issue. The same may be true for arguments that RBL helps students develop key competencies. In our sample, university teachers who argued in favor of RBL based on individual competencies ("skilled") did not actually support RBL. If the Cascade Model for justifying RBL is effective, however, it could provide strategies for specific epistemic interventions (see Table 2) to persuade faculty and others.

We discuss the results first in terms of their generalizability and then in terms of their relevance to research on epistemic cognition.

## 4.1 Generalizability

We discuss the generalizability of our findings from three viewpoints, methodologically, disciplinary and university governance culture.

(A) *Methodologically*: One major problem is that our study is based on *small numbers*. This means we must be cautious about making generalizations. Our finding that teachers who advocate for RBL by referencing "skilled" as an epistemic value do not teach RBL themselves should not be overemphasized. Instead, it should be classified under the overarching assertion and finding that RBL is more often supported at higher levels of the Cascade Model (i.e., scientific and professional). Another problem is that the study with the interviews was not intended to examine how university teachers are *persuaded* by the university or what arguments are used (thanks to one of the reviewers for pointing this out). The study was not designed to test the cascade model for justifying RBL. Using the interview study can be seen as an advantage because it allows for a more independent review. However, the disadvantage is clear: when university management tries to persuade teachers to adopt RBL, different mechanisms may come into play than those captured by our study.

(B) *Disciplines*: Disciplinary differences in our studey are not surprising: With Medicine, despite didactic support, RBL in the narrower sense was virtually absent in our sample. In Psychology & Education, didactic support by the university is not perceived and didactic self-initiative is advocated. In Psychology & Education, however, RBL in the narrower sense is found. We can assume that the specific logic of a discipline (more research orientation in psychology vs. more professional orientation in medicine) still plays a role in the curricula and for the self-image of university teachers and hence influences their attitude toward RBL. However, our studies within the RBL research network have shown that RBL exists in every discipline (Mieg, 2019a, 2019c), even though the understanding of research varies (Mieg, 2019b). Therefore, it is reasonable to use different measures for RBL depending on the discipline, for instance including problem-based learning in medicine (Trullàs et al., 2022; Wood, 2003). We acknowledge that using different measures can be considered a methodological weakness.

(C) *University governance cultures*: In Germany, scientific research and teaching are constitutionally protected freedoms (Fulda and Missal, 2022), which limits university governance. In particular, the ability of university management to prescribe teaching pedagogy is limited. Here, convincing the teaching staff is key for university management. This makes implementing reforms toward course-based RBL particularly difficult. However, it is easier to establish extracurricular RBL, such as non-university research experience, within an Undergraduate Research Opportunities Program, as is done in the US (Galli, 2022). In Germany, it may be effective to revisit the concept of the modern university as defined by Wilhelm von Humboldt, which was acknowledged by one of our interviewees:

> *That [RBL] is actually the basic principle of the university, if you understand it according to Humboldt, that you work together on a subject. Teachers as well as students. And I believe that the moment I engage in truly research-oriented teaching, the roles disappear.* (Interview 36, Psychology & Education Department, translated)

## 4.2 The link between the Cascade model and epistemic cognition

Although the Cascade Model for justifying RBL is set in the context of epistemic cognition, it does not employ standard definitions. While Chinn and Rinehart (2016) focus on epistemic aims, the Cascade Model focuses on epistemic values, which can be used to evaluate those aims. In this case, the values are scientific, professional, skilled, and social. These values lead to corresponding epistemic authorities, which are sources used to evaluate knowledge and are trusted because of shared values. This view of epistemic authorities differs greatly from the commonly held view in Schommer (1990), which considers epistemological beliefs that refer to authorities to be in need of further development.

The relationship between the Cascade Model and research on epistemic cognition, which has yet to be clarified, provides much material for further research. It seems time to clarify the concept of epistemic authority in this context (Chinn and Rinehart, 2016). This would also help clarify the relationship between university teaching and free speech. The dividing line may lie in systematic research, i.e., scientific research, and other ways we can approach truth (Blocher, 2019). In other words, the semantics of "truth" based on research differs from those linked to other values. In science *truth serves as value* (a conformity of propositions with reality), whereas in free speech the *(political/religious) values may serve as truths* (Mieg and Morris, 2025, p. 12). Therefore, it would be beneficial to learn more about the epistemological beliefs and epistemic cognition of university teachers. In this context, the Cascade Model for justifying RBL is only a first step that may help shed more light on the discussion of scientific thinking versus free speech.

Lastly, the big question remains: Can RBL promote epistemic cognition in students? We can also assume that university teachers can be seen as trusted authorities in developing epistemic cognition in students. However, as indicated by research in the RBL research network (Table 1), the arguments necessary to convince faculty of the merits of RBL may differ from those necessary to convince students.

# Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

# Ethics statement

The studies involving humans were approved by Ethikkommission bei der LMU München. The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

## Author contributions

HM: Visualization, Formal analysis, Validation, Writing – review & editing, Investigation, Software, Writing – original draft, Conceptualization. AH: Validation, Conceptualization, Data curation, Writing – review & editing, Writing – original draft, Investigation. MB: Investigation, Writing – review & editing. WD: Conceptualization, Writing – review & editing. JD: Investigation, Writing – review & editing. CG: Writing – review & editing, Investigation. AP: Writing – review & editing, Data curation, Investigation. IR: Investigation, Writing – review & editing. JR: Writing – review & editing. MS: Methodology, Writing – review & editing. TS: Investigation, Writing – review & editing. MF: Writing – review & editing, Supervision. JZ: Resources, Conceptualization, Supervision, Methodology, Data curation, Project administration, Validation, Writing – review & editing, Investigation, Funding acquisition, Writing – original draft.

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## Conflict of interest

The author(s) declared that this work was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

## Generative AI statement

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## Publisher's note



## Supplementary material

The Supplementary material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/feduc.2025.1650687/full#supplementary-material

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