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Guide: Designing a course for research-based learning

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Abstract

The combination of research and teaching is often characterised as a defining principle of the university. In practice, however, linking research and teaching is not simple, and may run the risk of losing sight of students' learning. This guide provides practical advice for designing courses that foster research-based learning. This involves engaging students in activities of research and inquiry on issues that are not entirely settled as well as creating an environment that supports the development of research competences of a diverse student population. The guide covers key steps in the course planning process – from selecting a topic to organising learning activities and assessment formats.

Practice points

1. Make learning goals and assessment formats that support a process of research and inquiry
2. Engage students in an unsettled research issue
3. Ensure participation and engagement through student ownership
4. Train students' research skills with different research-related activities
5. Scaffold student research competences
6. Create a supportive environment for exploration
7. Have students communicate their findings and provide feedback

Background

Research-based teaching is often considered a cornerstone in university education. It encapsulates a century-old idea of the university as an institution defined by an interplay between its two undertakings: research and education. This idea is commonly attributed to Wilhelm von Humboldt's vision for the University of Berlin, and it has had a significant impact in Northern European universities (Humboldt 2007 [1810], Barnett 2003, Hensel & Blessinger, 2020, p. ix). In Denmark, it is legally reinforced by the university's obligation to 'conduct research and offer research-based education at the highest international level within its academic fields.' (University Act, 2019, §2).

For most academics, research and teaching are the two most important activities in their professional lives. Experimenting with research-based teaching enables academics to develop knowledge through teaching, and

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gaining new insights from students' questions and contributions (Brew, 2006, p.126; Jensen, 2001). What this interplay involves and how to go about it, however, is not straightforward, and it can be organised in many ways (cf. Brew 2012, p. 105; Healy & Jenkins, 2009; Levy and Petrulis, 2012; Damsholt & Jensen, 2023).

Studies show that a central problem of research-based teaching is that it risks engaging only few students (Damsholt & Berg, 2018) or involve students in routine research tasks instead of formulating and investigating their own questions (Chang, 2005). This calls for a student-centred approach, where teachers create an environment that supports students in developing the knowledge, skills and competences needed for conducting research within their field.

In this guide, we offer tips on how you can design courses aiming at research-based learning. We draw on research showing that when students engage in processes of research and inquiry, they gain a deeper understanding of how scientific knowledge comes into being and develop the ability to critically evaluate knowledge (Healy, 2005; Jensen & Dikilitas, 2023; Kuh, 2008).

The concept of research-based learning implies reciprocity in learning so that 'faculty can learn from students as students are learning from faculty' (Boyer Commission, 1998; cf. Humboldt, 2007). For this to take place, it requires 'students conducting research and inquiry-based activities in which they exercise agency, develop research skills, and require a critical understanding of knowledge' (Zou et al, 2024; cf. Carnell & Fung, 2017).

Studies have shown that research-based learning experiences within course work prepare students for subsequent thesis work and equip them with skills for handling and producing new knowledge (Brew & Jewell, 2012; Neary & Winn, 2009). Research-based learning, thus, is not only important for students aspiring to a career as researchers, but for any student who is learning to critically evaluate scientific knowledge (Damsholt et al., 2018; Hughes, 2019).

The emphasis on students' research and inquiry has much in common with frameworks of inquiry-based teaching and problem-based project learning prominent in Roskilde and Aalborg University (Christiansen et al., 2010; Dohn & Dolin, 2013; Wulf-Andersen, 2015). In this guide, we focus on how to introduce research-based learning in course work, drawing on the Humboldtian idea of approaching scientific knowledge 'as a problem that has still not been fully resolved' (Humboldt 2007 [1810]; Nybom, 2003).

1: Make learning goals and assessment formats that support a process of research and inquiry

In designing a course for research-based learning, the intended learning outcomes and assessment formats should reflect students conducting research and inquiry-based activities. In an investigative process, it may be less clear what specific knowledge students should acquire. This can be handled by choosing assessment formats and learning objectives emphasising process and method mastery over acquired knowledge (cf. Gøtz, 2018). The learnings goals could reflect some or all of the following aspects of the research process, depending on the specific theme of the course: Formulation of research problem, selection and justifications of methods, critical assessment of empirical material, cooperation and knowledge sharing, conduct of research and ethics and dissemination of findings.

Misalignment between the exam and course activities may lead students to prioritise exam performance over engaging in the research process or feel misled for not doing so (Brew, 2012, p. 103-4, cf. Biggs & Tang, 2007). If you are designing a new course, carefully consider the relationship between what you want students to learn and how it should be assessed to support their learning. If you are restructuring an existing course with a predetermined exam format, consider its suitability for how you want students to engage. If it does not align with your goals, involve the study board or head of study to make changes.

- Assess the process: Central to research and inquiry-based teaching is creating exam formats that do not hinder students' engagement in exploring and discovering something new (cf. Brew, 2012, p. 103). Students may focus on exams or the products they must submit rather than the research process. Conversely, students may feel their engagement in research-based learning is wasted if the exam does not reward it.
- Allow for taking risks without penalties: Due to the uncertainty of research outcomes, make sure to design exams allowing students to 'take risks without penalties' during the course (Fung, 2017, p. 57). Portfolio formats can be a way of balancing process engagement and the final product while mitigating risks.
- Using authentic research products for exams: Incorporating formats common in the research field, such as (student) journal articles or poster presentations, can enhance students' perception that their work is authentic and not primarily a preparation for something else (Chang, 2005, p. 391). Consider combining these research products with an oral exam for students to present their work and respond to examiners' questions, similar to many thesis exams and projects.

2: Engage students in an unsettled research issue

In designing a course for research-based learning, choosing a topic that revolves around unsettled issues or problems offers students a chance to move beyond merely seeking the correct answer to a question (Levy and Petrulis, 2012). An issue is unsettled when no definitive answers have been found, or when new research methods may yield fresh insights. The topic does not have to break new ground, but it should be sufficiently open-ended for students to engage in exploratory learning (Brew, 2012). While the teacher's enthusiasm for the topic is valuable, this does not guarantee that students share this, or actively engage in learning (Damsholt & Sandberg, 2018).

Engaging with unsettled issues in academic settings offers students the chance to apply research methods and practical techniques pertinent to their field (Brew, 2012; Chang 2005). This helps them develop skills such as formulating research inquiries, selecting data sources, conducting investigations, and communicating analyses. You may want to start by identifying an existing aspect of your research field, which lends itself to students' inquiries.

- Why does this topic interest you as a researcher and teacher? (Explaining this motivates students)
- Is the topic open enough for students to work on it in different ways?
- Is it possible for students at this level to work with it, or does it need to be made more accessible by specifying processes, materials or methods?
- In what ways is the topic characteristic of ways of thinking and practising in the discipline?
- What research competences will students develop through the research process?

3: Ensure participation and engagement through student ownership

Research shows that it matters how students participate in research-based activities (Willison & O'Regan, 2006). Working with processes of research and inquiry can stimulate student interest and engagement, provided it challenges them sufficiently. Such engagement requires some degree of ownership of students in terms of what they are working on, and how they work. Supporting such ownership entails granting students agency and some degree of control and influence. You can create ownership by allowing students to contribute their perspectives, abilities, and questions or by providing opportunities for them to influence topic selection and how they approach a task (cf. Brew, 2013, p. 616). If students are engaged merely as cheap labour for a researcher but fail to see the relevance of what they do, they risk not learning much (Chang, 2005).

The key question to consider is: What decisions should students make about what they investigate, the methods they use, how they organise the process?

Students can acquire ownership by working on self-selected problems within a shared framework. For instance, they may choose specific problems within a broader investigation of source materials or select experimental substrates that appear particularly interesting to them.

Giving students agency may also involve allowing them to influence the methods used. Portfolio assessment, poster presentations, or written products such as articles, or technical reports are some of the commonly used formats that may also allow students high degrees of freedom in how they choose to report on their work. Often such formats will be used in conjunction with oral presentations.

4: Train students' research skills with different research-related activities

Students' engagement with research can take various forms (Damsholt & Jensen, 2023). Teachers' own research learning experiences often affect decisions on course design (Brew & Saunders, 2020). While this is a valuable resource, it may require diversification. When working with first-year students, Healy & Jenkins (2009) recommend a mix of content-oriented activities (learning about a topic) and activities that develop research competences and methods. They advocate for varying between guided activities and more student-driven ones.

In course planning, consider introducing variation through different activities that make students engage with research. For instance, incorporate activities such as engaging in discussions, searching for articles, formulating research questions, gathering materials, conducting experiments, listening to presentations, performing (expert) interviews, writing short texts, deciphering the communication styles of other researchers, presenting to peers, providing feedback, creating a model, or writing short texts for different audiences. Have the more teacher-directed activities support and lead into more student-driven activities. It may also be helpful for students to hear your perspective on how their work relates to knowledge in the field or discipline – i.e. helping the students generalise from their findings.

5: Scaffold student research competences

Most researchers understand that a research process is not straightforward but often a messy and recursive journey with dead ends and periods of doubt, sometimes generating more questions than answers (Becker, 1998, p. 9). Navigating such situations can overwhelm students (Ryberg, 2023, 2025). However, supporting them in handling large amounts of information or unexpected results can equip them with competences applicable in various scenarios. Students acquire such competences through experience.

Structure the course to outline tasks and methods while allowing flexibility for students to pursue interests and take ownership. Students should perceive the tasks as manageable, supported by scaffolds – structures aiding students in reaching their 'zone of proximal development' and removed when no longer needed (Bruner, Wood & Ross, 1976; Doo et al, 2020). To make such a scaffold, you need to have a sense of what the students already know and have clarified what they need to be learning. Some students thrive in unfamiliar terrain, but many require guidance to see the next steps. The key question is: What activities may support students' decision-making and development?

To scaffold the development of students' research competences, you can:

- Assign specific questions, tasks, or milestones to work on.
- Provide examples similar to students' tasks and outline the research process steps or feedback questions can aid comprehension.
- Outline concrete questions and a clear process structure with defined activities for novice students. Progressively, you can engage students with abstract or open-ended questions within a structured framework, eventually leading to self-directed inquiry (Willison and O'Regan, 2006).

6: Create a supportive environment for exploration

Research can be daunting. While some thrive on exploration and academic contribution, requiring freedom, inspiration, and occasional guidance, others need more support. Simple strategies can foster a safe learning environment, accommodate diverse backgrounds and support the students through uncertain research phases (Tanner 2013).

To create an inclusive learning environment for research-based learning:

- Know your students and encourage peer connections: Use name tags, take photos on the first day to learn names, and consider fixed groups in larger classes for added security.
- Embrace mistakes: Highlight mistakes as integral to learning and research. Explicitly allow for unexpected outcomes, allocating time for sharing solutions and forging new paths.
- Promote social interaction and collaboration: Cultivate a welcoming atmosphere for collaboration. Students learn from both informal discussions and formal presentations, questions, and feedback.
- Offer flexible and structured time: Provide extended hours in labs or archives to accommodate varying paces. Organise time with flexibility and deadlines to cater to diverse speeds and learning styles while ensuring goal achievement.

7: Have students communicate their findings and provide feedback

Research indicates that learning is facilitated through communicating about the subject matter (Prain & Hand, 2016). It is widely acknowledged that communicating in various formats not only enhances communication skills but also consolidates insights and fosters deeper understanding (Howard & Barton, 1986; Scardamalia & Bereiter, 1987). A crucial aspect of the research process involves translating knowledge across domains (Latour & Woolgar 1979, p. 45). When planning a course, supporting learning processes through activities that prompt students to communicate their research and discovery is essential. Additionally, discussing the inquiry process can enhance students' understanding of connections in a research process and support metacognitive reflections, aiding comprehension, and progress monitoring (Harris et al., 2009). Engaging in discussions about fellow students' work can help students recognise that their own learning experiences are shared among their peers. As a teacher, having students share unfinished work enables you to offer feedback and track their progress.

- Mix communication formats: Encourage students to communicate their analytical insights through various means, including written analyses, oral presentations, or visual representations such as illustrations, models, or poster presentations. Vary the questions, format, or target audience.
- Foster process communication: Create opportunities for students to articulate their approach to the process and share their learning journey. This can be achieved through journals, podcasts, portfolio reflections, oral brainstorming sessions, or online platform writing. Encourage ongoing reflection: how well are we achieving what we planned? What new questions have emerged? What is the next step?

- Integrate feedback and peer feedback: Effective feedback supports student learning (Hattie & Timberley, 2007). Studies on peer feedback suggest that students learn more by providing feedback on similar tasks they are working on (Nicol et al., 2014). When soliciting feedback, students learn to evaluate others' work and develop research competences. Establish assessment criteria linked to learning objectives and discuss them with your students.
- Engage real audiences: Students often find it motivating to communicate their research to real audiences or stakeholders. This provides practice in conveying knowledge to someone outside their field, as they may encounter in future careers (Horst, 2018; Guile & Evans, 2012).

Conclusion

In this guide, we have offered advice for designing courses aimed at developing students' research competences by engaging them in research or research-like activities. We have highlighted that creating a research-based learning experience involves giving students opportunities for getting practical experiences analysing unsettled knowledge and working with research methods, approaches, and processes that are central to knowledge creation in their field. There are many examples of how this can be done across various disciplines (cf. Healy & Jenkins 2009, fbu.ku.dk).

The advice of this guide could apply to a wide range of teaching contexts. Yet, being clear on basic questions such as how students participate, how research skills are scaffolded and if assessment formats align with the course activities, is particularly pressing if all students are to benefit from engaging with open-ended issues and research approaches. Engaging students in research activities taking these issues into consideration will not only provide students with a fundamental understanding of the conditions of scientific knowledge-making but also strengthen their competences in managing inquiry processes and researching new areas. These competences are crucial for university education and essential in a world where crises and new technologies require the ability to critically assess knowledge and handle new problems.

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