Part II

Chapter 4. Integrating skills in curricula: An analysis based on the 4C/ID model

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4.1 Introduction

This chapter engages with the current trend and ambition in academic education to develop learning trajectories in curricula. This implies a consistent and reflexive alignment of final qualifications, learning objectives, courses and assignments. We will focus on the development and implementation of skills trajectories in a few selected UM bachelor's programmes.[1] This chapter provides both strategic theoretical advice and a description of best practices. In particular, this chapter will build upon the 4C/ID-model. This model contains four components: learning tasks, supportive information, procedural information, and part-task practice. To be effective for learning, these four components should be reflected in the training of research skills in curricula. In this chapter, the model will be compared to best practices at UM faculties. Based on this comparison, its pro's and con's will be evaluated.

This chapter will focus on three UM bachelor's programmes and the ways in which they try to integrate skills into their curriculum: Arts & Culture (FASoS), Health Sciences (FHML) and European Law School (Law). The chapter will first describe and compare the way in which the final qualifications for these programmes and the master's programme Physician-Clinical Investigator are formulated and which research competencies (in terms of knowledge, skills and attitude) are defined. Second, we will describe a model for embedding learning trajectories into curricula: The *Four Components Instructional Design (4C/ID)* model. We will present what a learning trajectory for teaching students the research competency of 'conducting a literature review' could look like, following the 4C/ID model. Third, we will describe three examples of research skills learning trajectories at UM: the research and writing track within Arts & Culture, European Law School's skills track and the academic writing trajectory within Health Sciences. We will reflect on the strengths and weaknesses of the way these learning trajectories are set up, and compare them to the 4C/ID model. Fourth, the chapter draws out some best practices from the cases and considers strategic issues in the setting-up of new learning trajectories. This part of the chapter provides some strategic lessons that can be used by programmes that plan a curriculum revision or want to design a new learning trajectory.

4.2 Comparison of final qualifications

The 4C/ID-model was developed by van Merriënboer (1997) as a model for complex or whole-task learning. Complex learning refers to the integrated acquisition of knowledge, skills and attitudes and aims at transferring what is learned in a formal context (e.g., at university) to daily life or

[1] In this chapter, we will not focus on MaRBLe, although this program is an excellent example of training bachelor's students in research skills. For more information on MaRBLe, and the application of 4C/ID within various MaRBLe programmes, see Bastiaens et al. (2017).

professional settings (van Merriënboer & Kirschner, 2013). In the 4C/ID-approach, curriculum development and revision starts by looking at the final qualifications and the definition of competencies. Therefore, we have looked into which research competencies (knowledge, skills and attitudes) are defined in the final qualifications of three UM bachelor's programmes and one master's programme. Furthermore, we studied how bachelor's research competencies compare to master's research competencies. Which level can we expect to reach in a bachelor's programme?

The final qualifications of European Law School, Arts & Culture and Health Sciences are quite similar regarding the research skills they address. They all contain skills such as problem definition, selection of relevant material, critical reflection, academic writing, and the application of research methods. The qualifications of European Law School and Arts & Culture also classify multi- or interdisciplinarity (or approaching a problem from different angles) as relevant research skills. The final qualifications of Health Sciences include social skills such as learning to collaborate in groups and 'reflecting on science and scientific discussions, on the relationship between science and society, and on their own future role as scientists/expert/professional'.

The final qualifications of the master's programme Physician-Clinical Investigator are much more detailed. This is most likely due to the programme's professional orientation. Through a scale from 1 to 5 (with 5 being the most advanced), the qualifications state the level of competence students should have reached. Interestingly, the structure of the final qualifications for Physician-Clinical Investigator follows the research process. A graduate "is able to design and conduct a small-scale empirical scientific study" and thus:

- can formulate a problem statement and research question;
- conduct a literature review;
- can design an appropriate methodological approach;
- can collect data;
- do basic data-cleaning and data-input;
- can do a basic statistical analysis;
- can write a report on the results;
- can present and discuss research results.

Sumner et al. (2010) differentiate between requirements at the bachelor's and the master's level by distinguishing requirements regarding the research question, content-related knowledge and independence. For instance, the relevance and originality of the research question are less important in bachelor's research projects, whereas master's students generally study a question that is not yet dealt with satisfactorily in the existing academic literature. Furthermore, bachelor's theses can be based on textbooks (and a few articles), whereas master's theses should also include references to sources such as PhD theses and academic (legal) journals. Finally, bachelor's students generally receive guidance and supervision throughout their thesis period. A master's student is expected to formulate a research question, conduct research and report the results without much guidance (Sumner at al., 2010, pp. 64-65).

In the next section, we will focus on training one specific research skill: conducting literature research. We will describe how conducting literature research can be trained in accordance with the 4C/ID model.

4.3 Training students to conduct a literature review in accordance with the 4C/ID-model

Within the 4C/ID-model meaningful, authentic realistic learning tasks form the starting point and backbone of an instructional programme (van Merriënboer, 1997; van Merriënboer & Kirschner, 2007). These tasks orient the learner to the end goals and competencies that need to be acquired. The learning tasks are chosen in such a way that they represent the tasks of a professional. They are called *whole-tasks* or complex problems. To facilitate transfer of learning, the tasks vary from one another as they would in a real-life situation (Norman, 2009). For instance, within the context of learning research skills, *searching for literature to answer a research question* could be an authentic learning task. Using the approach of whole-task learning, as proposed in the 4C/ID-model, provides a solid framework for the development of learning activities that foster students' functioning in variable and complex settings (Yardley, Hookey, & Lefroy, 2013). As a result of using a whole-task approach, the development of a rich set of mental models and cognitive strategies is facilitated, allowing students to use efficient problem-solving strategies in various situations.

A learning trajectory based on the 4C/ID-model is composed –as its name suggests- of four components (see Figure 4.1):

1. Learning tasks
2. Supportive information
3. Just-in-time or procedural information
4. Part-task practice

These components are explained in more detail in the next sections. Furthermore, the application of the four components in instructional design is explained by presenting an education design for the complex skill 'Conducting a literature review', a constituent skill of the complex skill *'Developing research skills'*.

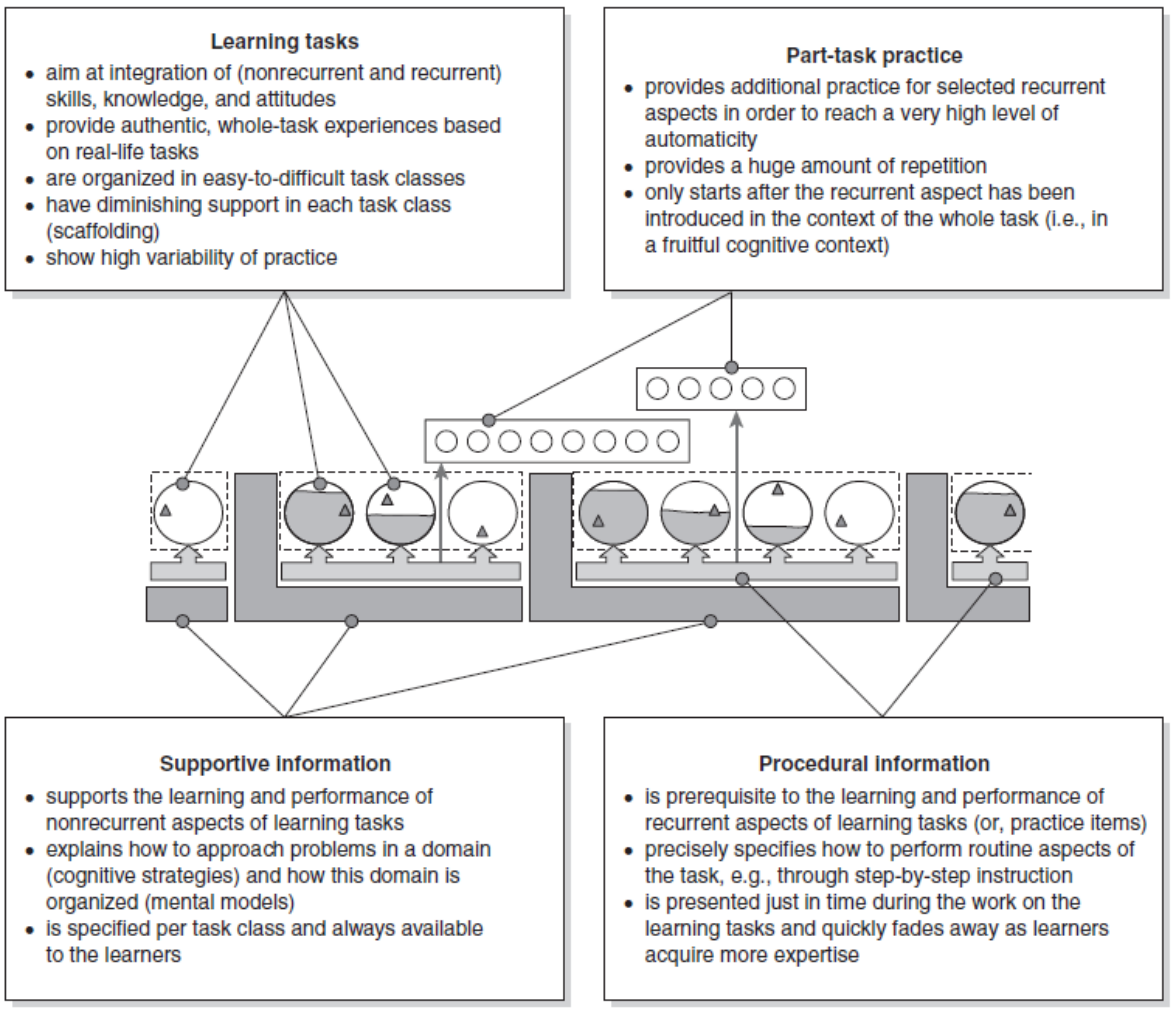


Figure 4.1 4C/ID-model (Kirschner & van Merriënboer, 2008, p. 247)

4.3.1 Learning tasks

Figure 4.2 4C/ID-model

In order to define realistic learning tasks, the different constituent skills that are involved in performing the skill should be defined first.

Box 4.1 Learning tasks

The following skills are essential in the process of conducting a literature review: 1) define question(s), 2) search for sources, 3) select sources, 4) process information, 5) present information. Taking these skills into account, an authentic realistic learning task for conducting a literature review could be:

The student is provided with a newspaper article on 'Diet Bibles' and is asked to prepare a debate on the usefulness of a diet.

Most learning tasks include both routine and non-routine aspects. For instance, when conducting a literature review, selecting the databases or making a list of search terms can be seen as recurrent. Non-routine aspects are actions that are rather new to students, require effort and have a problem-specific outcome. They are also called *non-recurrent* aspects to indicate that they still require problem solving, reasoning or conscious decision making also after students have finished their educational programme. For instance, in the literature review example, deciding on the topic of the review, which literature to include and exclude, etc.

One of the assumptions of the 4C/ID-model is that for the acquisition of competencies, the learner should be confronted with a varied set of tasks. These tasks are clustered in *task classes* according to their complexity (see the dotted lines around the circles in Figure 4.2. That is, within one task class all learning tasks are equally complex but differ from each other on all characteristics on which professional tasks may also differ from each other. Task classes differ from each other as they comprise tasks of a different complexity level requiring different knowledge or more elaborated knowledge for their successful performance.

To compose these task classes, one must define the simplifying assumptions of the complex skill. That is, which conditions influence the complexity of the performance of the skill?

Box 4.2 Defining simplifying assumptions

The following simplifying conditions can be identified for the process of conducting a literature review:

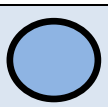
- The type of review: narrative and/or systematic reviews are less complex than a meta-analysis.
- The language of the articles: articles written in the native language are less complex than articles written in a foreign language.
- The problem definition: well-defined problems or topics are less complex to research than ill-defined problems or topics.

As explained before, the learning tasks in one task class have the same level of complexity. However, they do differ regarding the **amount of support** provided to learners when performing these tasks. Much support is given for learning tasks early in a task class, and no support is provided for the final learning task in a task class. This process of diminishing support as learners acquire more expertise is called *scaffolding*. In Figure 4.1 this is indicated by the diminishing filling in the circles.

Box 4.3 Define variation in learning tasks and design support

Table 4.1 provides an example of conducting a literature review, where the variation in learning tasks within one task class and the gradual withdrawal of support is illustrated, as well as the implications for the role of the instructor (tutor) and the student.

Table 4.1 Diminishing support and evolving role of student (S) and instructor (I) in a series of learning tasks in a task class (or block)[2] [3]

					
Constituent skills	PBL –training / learning task 0	Learning task 1	Learning task 2	Learning task 3	Learning task 4
Define question(s)	S: study example I: explain, model	S: study example I: explain, model	S: study example I: explain, model	S: study example I: explain, model	S: define question(s)
Search for sources	S: study example I: explain, model	S: study example I: explain, model	S: study example I: explain, model	S: search for sources	S: search for sources
Select sources	S: study example I: explain, model	S: study example I: explain, model	S: select sources	S: select sources	S: select sources
Process information	S: study example I: explain, model	S: processing info, analyse, link with question	S: processing info, analyse, link with question	S: processing info, analyse, link with question	S: processing info, analyse, link with question
Present information	S: study example	S: present info	S: present info	S: present info	S: present info

Regarding the instructions for a literature review, the first learning task could involve an example which demonstrates the entire process of the literature review and the different constituent skills involved. It is important to explain the decisions that have been made by the author, but also to stress rules and restrictions (for instance, explaining why a blogpost on the internet is not a valid source). This can be done through a video-recorded modelling or the tutor explaining and modelling the whole process, or during a PBL-meeting. The topic of the literature review is then related to the content of the course. In the next learning task students perform the first step themselves. In the subsequent learning tasks the amount of guidance gradually decreases. Table 4.1 provides an overview of the different constituents and different learning tasks, and demonstrates how the role of the student changes throughout the process. Completion forms can be used to structure this

[2] This example is strongly based on Wopereis, Frerejean, and Brand-Gruwel (2015).
[3] Instructor can refer to the PBL trainer, a video recorded worked-out example, a tutor etc.

process and to ensure that each learning task addresses the constituent skills. The form is filled out completely for the first learning task, and gradually leaves more space for students to complete the exercise.

4.3.2 Supportive information

Figure 4.3 4C/ID-model

In order to be able to address the different learning tasks, students will need some supportive information (thick grey lines Figure 4.3), to have the necessary prior knowledge to start working on the tasks. In the case of giving presentation on the analysis of a scientific article or a research report, the supportive information may include pointers on deciding what should be reported, how to address the public, elements to be included (for instance, references), copyright issues etc. Such information is available to the students during all tasks (over the different task classes). Supportive information may also include cognitive feedback on task performance. This entails elaborate feedback on students' performance, presenting possible solutions and providing insight into the problem-solving approach (decision process) to reach the best solution.

Box 4.4 Determine the required supportive information and cognitive feedback

Determine which information students need, to conduct a literature review. Provide students with an overview of what kinds of literature reviews exist, what the aim is of a literature review, the general structure of a research article, structural models of how databases are organised and can be used. This information can be provided in a lecture, through video-material or handbooks. Cognitive feedback can be provided after every learning task, or before the final and most complex task. While the role of the 'instructor' decreases with respect to the execution of the task, their role may increase with respect to providing cognitive feedback to the students.

4.3.3 Procedural information

Figure 4.4 4C/ID-model

Procedural information is information (black lines Figure 4.4) that students need just-in-time, when they are working on the task. The information is task-specific and assists students in the performance of the task. It often refers to recurrent aspects of a task, aspects that are often performed routinely in a professional setting. This information is often provided in a step-by-step manner. The flow of information gradually decreases as students gain more knowledge.

Box 4.5 Determine the required procedural information

The procedural information will differ for each learning task. For learning task 1, students may receive information on how they can analyse and present their results, the use of tables or graphs, information about what needs to be included when presenting results, procedures used in academic writing, APA referencing system, etc. For learning task 2 this may be information on the reliability of resources, information on what kind of sources have been used (peer reviewed, handbooks, etc.). For learning task 3 this may include a tutorial on how to search databases, how to determine your descriptors, how to use Boolean operators, etc. For the final learning task, this may be information on how to construct a good research question and the difference between open and closed questions. Again, the medium used to provide this support may differ. This procedural information may be provided by the tutor, or through online materials that students can consult just-in-time.

4.3.4 Part-task practice

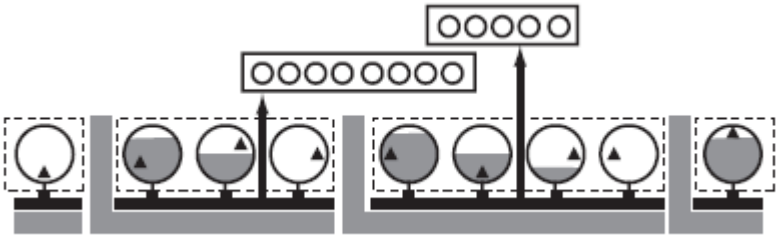


Figure 4.5 4C/ID-model

Part-task practice (small rounds in Figure 4.5) is provided by exercises related to the acquisition of routine skills; skills that need to be automated to increase the capacity/time for working on non-routine tasks. Such tasks are not always part of the learning environment.

Box 4.6 Determine part-task practice

The use of Boolean operators could be a part-task practice, in the process of learning to conduct a literature review. Additionally, activities such as APA referencing and creating tables and graphics, could be part of this part-task practice. Part-task practices can be trained through online exercises and PBL training sessions.

In the next section, we will discuss a real-life example of a learning trajectory that trains students to conduct a literature review. We will compare this practice with the 4C/ID-model.

4.4 Real-life examples of skills learning trajectories at UM

4.4.1 Research & Writing skills - Arts & Culture

The bachelor's programme Arts & Culture/Cultuurwetenschappen offers a learning trajectory in research and writing skills. The trajectory is comprised of two courses, spans 1.5 years and starts in period 1 of the first year. Upon successful completion, students receive 7 ECTS in year one and 7 ECTS in year two.

The main aim of the trajectory is to help students develop key skills which they will need to successfully complete their bachelor's thesis at the end of the programme. Students write an academic paper for each Research and Writing course. The 3000-word paper for '*Research and Writing I*' must be connected to the course's theme 'memory'. Students attend weekly lectures by FASoS staff members presenting their research on (cultural) memory. The lectures off explanations of key concepts and examples on how to study memory from a cultural perspective. The paper for '*Research and Writing II'* has a length of 6000 words. Students are free to choose their own topic within the field of Arts and Culture. The assessment criteria for both papers are based on the criteria for the bachelor's thesis. The expected level of competencies is higher for the second-year paper.

In addition to writing research papers, students also complete other tasks in order to develop and practice relevant skills. In the first period of year 1, students are asked to write a summary of an academic article. Naturally, students get plenty of help from their tutor and receive individual feedback on their progress. The learning task becomes a bit more complex in the second period: students must compare two academic texts from key scholars within the field of memory studies. This involves reading skills, summarising, juxtaposing two different perspectives, and evaluating the arguments and evidence the two texts present. Again, students are supported by the feedback of the tutor, who particularly pays attention to the quality of language and the ability to reproduce authors' key arguments in a coherent and well-structured way. Students are encouraged to revise, improve and resubmit what they have written. In the second year students write a literature review, thus combining the skills of the two previous exercises by providing a connected overview of five to seven academic sources. Building on this literature review, students then formulate a proposal with a productive and feasible research question for their final paper.

Throughout the skills trajectory, students can consult an electronic learning environment containing supportive and procedural information. For example, a checklist assists students with the application of the rules for correct formatting and referencing. Another important component is the *Digital Information Skills* tutorial, developed by the University Library. This online tutorial provides information, exercises and support to make students more competent in their search for relevant secondary sources.

Other resources include lecture slides, instructional videos, background articles, examples, guidelines and feedback forms.

Formative feedback is a key aspect of the entire training. The structure of the trajectory contains many opportunities for feedback, such as regular group meetings, individual feedback meetings with the tutor to discuss draft versions of the papers and assignments, an oral presentation on the paper in year one and a peer review exercise in year two.

4.4.2 Skills training - European Law School

The European Law School offers a course trajectory aimed at developing skills used in legal education.[4] These skills include the classically trained skills such as the ones mentioned at the beginning of this chapter (e.g. problem definition, selection of relevant material, critical reflection, academic writing, and the application of research methods). This view on skills training is rather traditional as it goes hand in hand with accreditation requirements that mostly reflect generally

[4] The features and background of this program have been extensively covered in Annex III

accepted standards for higher education such as the Dublin Descriptors. However, a Law School programme that does not exclusively train students to accede to standard legal professions or academia is a niche type of study, and it is necessary to build on this foundation with further skillsets for employability reasons. To this end, the skills trajectory of the European Law School includes 21st-century skills/competencies such as communication skills, collaboration and creativity.

The skills trajectory within the European Law School is comprised of four courses: Skills: *Legal Research and Reasoning, Skills: Introduction to Comparative Law*, *Moot Courts*, and *Academic Legal Writing*. All courses entail a combination of hard skills (e.g. research skills) and soft skills (e.g. communication skills), albeit with a different distribution. This paragraph focuses on the course *Skills: Introduction to Comparative Law*, which takes place in period 4 and period 5 of the first year. The primary purpose of the course is to provide students with a general overview of the uses of comparative law, through legal research, writing and a moot court exercise.

While the course was not designed in accordance with 4C/ID, it does bear some similarities to the model, as both the course and the model underline that the student must be confronted with a varied set of tasks. The tasks range from drafting a contract, drafting a translation of a given legal text, as well as collaborating, within a team, to the realisation of a written memorandum submitted for the purposes of the moot court exercise. Additionally, the course works with the concept of '*mastery learning*'. Students are allowed to revise the first two tasks once, and incorporate the feedback they receive in their initial assignments.

The course aims to enhance students' self-reflection skills by providing them with questions to guide their research during the first two assignments (e.g. ask students why they trust specific sources, etc.). For instance, in drafting a contract, students are asked to use examples of contracts which they find on the internet or through independent research (e.g. contacting notary offices, etc.). Students are allowed to use such examples, provided that they explain how they have investigated the trustworthiness of the respective source.

4.4.3 Academic writing trajectory - Health Sciences

Over the past two years, a completely new academic writing trajectory was developed and implemented into the bachelor's programme Health Sciences.[5] Within this trajectory, students are trained to write an academic report. In the past, student reports were evaluated by many different tutors. Consequently, the feedback on papers appeared to be inconsistent. Due to the large number of students enrolled in the programme, it was not possible to implement a system of individual supervision.

The programme found a solution in assigning a mentor to students, who evaluates and provides feedback on each of his students' papers throughout the year. This approach allows the mentor to track students' progress over the course of an academic year and to provide them with accurate feedback on their work. Students' progress in academic writing and their mentor's formative feedback is stored in an electronic portfolio system. Due to the large number of students enrolled in the programme, the feedback sessions are organised in groups of three students.

[5] This section is mainly based on an interview with dr. Herma Roebertsen, the 'founder' of this Academic Skills trajectory. Interview conducted by Geraldine Clarebout and Henrietta Hazen.

The skills track was designed with the 4C/ID-model in the back of the mind. The learning task of writing a paper is divided into various sub-tasks with increasing degrees of complexity. Students first deliberate the topic and write an introduction. Subsequently, they write an introduction and a method section. During the fourth and final step, the paper is completed. The mentor provides feedback on the first three assignments. The final product receives a (summative) grade.

4. 5 Conclusions: Strategic lessons and best practices for designing research skills trajectories
In this final section, we will single out some strategic lessons for designing learning trajectories for training (research) skills.

The cases described in this chapter show quite different approaches to developing skills trajectories. In the case of European Law School, the choice was made to explicitly broaden the traditional academic research skills with 21st-century skills such as collaboration, creativity, leadership and communication. Such skills are perceived as vital elements in enhancing students' employability. Therefore, this skills track can be considered a best practice. European Law School is one of the few programmes that explicitly train consultancy and global citizenship skills, in addition to traditional academic and research skills.

Another difference between the programmes is the degree to which the alignment of skills throughout the programme and with content courses is prioritised. The Law faculty, for instance, perceives integrating skills training within substantive courses as less beneficial. It is rather preferred to train these skills in project-based or simulation-based activities. According to the faculty, such skills can be trained in stand-alone courses without necessarily further aligning them with other skills trainings. In contrast to the Law faculty's approach, the Arts & Culture Research and Writing trajectory (FASoS) is characterised by a comprehensive set-up spanning two years. It follows the tenets of 4C/ID in the sense that it takes the 'whole-task' of the bachelor's thesis as a starting point to define its intended learning outcomes and assessment requirements. The course is designed to balance student responsibility and ownership of the learning process with clear and effective guidance. Thus, the 4C/ID-model seems to fit better with FASoS' approach than the method of the skills training at the Law Faculty. Although the skills trainings at European Law School equally start from real-life learning tasks (such as drawing up a contract), the alignment of skills throughout the curriculum is less prioritised. In that sense, the research and writing trajectory at FASoS is an example of a best practice in combining real-life tasks and decreasing degrees of support in a long learning trajectory that spans two years.

FHML (Health Sciences) aligned key academic skills in a learning trajectory. The faculty set up a completely new track to teach students how to write academic reports. A system of formative feedback was developed in which students receive feedback from the same mentor. The learning task of writing a report is divided into separate assignments in which students write an introduction, followed by an introduction and a method section, and so on. An 'academic skills working group' was established to guarantee a proper description of the various assignments and to make sure that the assignments gradually became more complex and that support gradually decreased (cf. the 4C/ID-model). Moreover, the faculty introduced a 'knowledge atelier' – a repository with all important academic skills-related documents, assignments and sources, accessible for all students and staff members. This practice of staff collaboration in a skills committee and establishing a repository with relevant information, is another best practice.

Box 4.7 Three best practices

- LAW: broaden-up traditional academic skills and link them to 21st-century skills to enhance the employability of our graduates.
- FASoS/FHML: align academic skills throughout the curriculum, start from small learning tasks, gradually increase the complexity of tasks, adapt the level of supervision by tutors.
- FHML: collaborate in working group to enable a clear coordination between learning tasks and create an archive for relevant material to be consulted by both staff and students.

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