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Adopting Principles of Freinet Pedagogy for Research Skill Development in Higher Education

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Zusammenfassung

The development of research skills in higher education curricula is considered an important component for personal and professional development. Empirical evidence shows that students' autonomy and creativity when performing research can be effectively supported by open, work-centric learning settings. The present work builds upon these results and proposes an approach that draws from the concept of work-based learning in general and the ideas of Freinet pedagogy in particular. The article reviews the state-of-the-art in research on the deployment of Freinet pedagogy in higher education and introduces a course design on scientific work and writing practices based on Freinet principles. It discusses findings from three cycles of action research on this course in an undergraduate business information systems curriculum, and reports on its evolution over time. The results show that Freinet principles can be de-ployed in higher education, but require adaptation to account for the high workload and limited flexibility of current curricula. These findings are used to discuss potential implications for curriculum design and higher education policies.

Keywords: Student Autonomy, Research Skill Development, Reformatory Pedagogics

Einsatz von Freinet-Pädagogik zur Entwicklung von Forschungskompetenz in der akademischen Lehre

Abstract

Die Entwicklung von Fähigkeiten im Bereich wissenschaftlicher Arbeitstechniken ist ein wesentlicher Bestandteil akademischer Bildung. Offene, arbeits-orientiere Lernansätze können die Entwicklung von Autonomie und Kreativität der Studierenden in der Durchführung von Forschungsaufgaben fördern. Diese Arbeit führt ein Kursdesign ein, das auf dem Konzept der Arbeitspädagogik aufbaut und Techniken der Freinet-Pädagogik einsetzt. Der Artikel legt den Stand der Forschung zum Einsatz von Freinet-Pädagogik in der akademischen Lehre dar und stellt ein Kurs-Design zur Einführung wissenschaftlicher Arbeitstechniken vor. Die Umsetzung wurde über 3 Action-Research-Zyklen in einem Curriculum der Wirtschaftsinformatik begleitet. Der Artikel fasst die gewonnenen Erfahrungen und die Evolution des Konzepts zusammen. Die Resultate zeigen, dass der Einsatz von Freinet-Prinzipien in der akademischen Lehre möglich ist, die Eigenschaften aktueller Curricula hinsichtlich hoher Arbeitslast und geringer Flexibilität aber berücksichtigt werden müssen. Diese Ergebnisse bilden die Grundlage für eine Diskussion der Implikationen für die Konzeption von Curricula und hochschulpolitischer Maßnahmen im Allgemeinen.

Schlagwörter: Autonomie von Studierenden, Entwicklung von Fähigkeiten in wissenschaftlichen Arbeitstechniken, Reformpädagogik

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1. Introduction

Developing scientific research skills is an integral part of academic curricula on both the undergraduate and graduate level (A. Marušic/M. Marušic 2003; McNeill 2009). Academic education in this field is particularly challenged on the undergraduate level by current trends of re-orienting curricula towards professional employability, e.g., as triggered by the European Bologna-process (Sin/Neave 2016). However, there is evidence that facilitating the development of such research skills is beneficial for students' cognitive, personal, and professional development already on the undergraduate level (Hunter et al. 2007; Hobson et al. 2015; Ganobcsik-Williams 2006).

Courses in scientific work practices often focus on topics like formulating scientific questions, literature research, structuring of an article or correctly referencing sources (Rice 1998; Rönnebeck et al. 2016). These techniques are often complemented by introducing students to skills related to scientific inquiry in general, such as analyzing, interpreting and evaluating data, engaging in argumentation or communicating scientific results (Etkina et al. 2010; Rönnebeck et al. 2016). In addition, literature stresses the importance of aiding the development of students' identities as "scientists" (Hunter et al. 2007). This includes building confidence in autonomously engaging in scientific inquiry and discussion, as well as understanding the nature of research work and establishing collaborative working relationships with co-researcher and -authors (ibid.).

Evidence from existing studies shows that learning about research process efforts can be effectively supported in participative settings (Lambert 2009) in which students can actively engage in planning, conducting, writing and presenting their own research (Hobson et al. 2015). Active engagement of students can be facilitated by an experience-oriented, work-based approach (Raelin 1997; Hughes et al. 1999) to teaching. Work-based learning is mainly characterized by a series of action-reflection cycles in which learners engage with tasks requiring the skills to be learned, and subsequently reflect upon the observed effects and learnings (Raelin 1997).

Existing research in this area proposes the use of mentoring practices (Hobson et al. 2015) or facilitated peer learning (Bräuer 2012; Reynolds/Thompson 2011). These approaches provide a participative way to introduce students to research techniques. They, however, do not explicitly facilitate the development of a self-directed, creative style of working, which is considered as important and desirable for successfully conducting research (Hunter et al. 2007). Open educational settings in turn appear to cause these effects and facilitate the development of a self-directed, creative style of working (Giaconia/Hedges 1982).

This article aims at combining work-based learning approaches with open educational settings, and presents a concept for a higher education course that focusses on students' self-directed skill development in the field of scientific writing and inquiry.

Work-based education focusing on students' autonomy and enquiry is not a novel concept. It dates back to Dewey and has been picked up in the early 20th century by educational reformists (Pihlgren 2006). The approaches proposed by Célestine and Élise Freinet in particular are grounded in the idea that skill development can be facilitated by enabling students' autonomous work and collaboration when working on practical problems in an open educational setting (Eichelberger/Laner 2003). This work hypothesizes that their concepts can be used for the aims described above. Consequently, the research question this article aims to answer is how (and if) courses can be designed based on Freinet principles to facilitate both the development of the ability to deploy scientific working techniques when working on own research problems, and the development of abilities to approach research tasks in a self-directed, creative way of working.

The nature of the research questions requires a design-based approach to research in educational settings (Collins 1992; Barab/Squire 2004; Reinmann 2005). Design-based approaches require grounding in existing theory, based on which design interventions are planned and executed (Barab/Squire 2004). They are iterative in nature, i.e., the design is modified based on observations from earlier implementations of the design (ibid.). Consequently, design-based approaches may generate new theories that are generalizable to a class of problems (Edelson 2002). Design-based research is always situated and thus requires thorough documentation of the context and the design process when reporting on it (Shavelson et al. 2003).

Consequently, the remainder of this work is organized as follows: The subsequent section outlines the methodology deployed to conduct the present research. Next, we establish the theoretical grounding by reviewing the existing body of relevant literature on Freinet pedagogy and its adoption in higher edu-

cation. The article continues with a section describing the principles guiding the design of the proposed course. This is based on original Freinet concepts and their interpretation as proposed by literature in light of today's changing learning environments. In particular, developments of information technology over the last decades are discussed, as they have been recognized as enabling open pedagogical approaches even under the strict formal and temporal constraints of contemporary curricula driven by the aims of the Bologna Process (Reinmann et al. 2007). Section 5 presents the theory-informed initial design on a course for scientific writing practices. Section 6 reports on the evaluation and evolution of the design, which has been carried out over three cycles of action research. In the final section, we summarize our findings, discuss generalizability and outline potential implications for higher education institutions as well as future curricula and course designs.

2. Methodology

The aim of this work is to examine how courses can be designed based on Freinet principles to facilitate both the development of skills in scientific work practices and the development of students' identities as "scientists". As the formulation of this aim already indicates, it must be approached by a design-oriented methodology.

Design-based approaches are relatively novel in educational research. Their roots as systematic methodologies in educational science can be found in the early 1990s (e.g., Collins 1992). Motivated by technological advancements, Collins (1992) set out to construct "systematic science of how to design educational environments […]" with the aim to "determine how [such environments] contribute to learning, cooperation, and motivation". Design-based approaches in educational science have been further conceptualized focusing on potential outcomes (Edelson 2002) and on the process (Shavelson et al. 2003) of design-based research (also referred to as "design science"). While design-based approaches have also been devised for educational settings in general (Barab/Squire 2004; Reinmann 2005; Mor/Winters 2008), technological innovation and its use in learning and teaching settings still appear to be the main drivers of design-based research in educational science (Laurillard 2013; Beetham/Sharpe 2013).

Design-based research is always embedded in its practical area of application and has to be grounded in existing theory (Barab/Squire 2004). The design process is iterative, and requires adaption to the design based on empirical findings stemming from practical deployment of earlier revisions. As such, it bears close resemblance with action research (Järvinen 2007). However, design-based research and action research are considered to act on different levels — design-based research is a strategy, whereas action research is considered to be an empirical method (Iivari/Venable 2009). Action research thus can be deployed within a design-based research process to implement the required evaluation activities (Venable 2006).

We follow a design-based research process as outlined above in our research. The theoretical grounding of the proposed course design is found in the concepts proposed in Freinet pedagogy and their potential implementation in modern, IT-supported higher education settings. As the later aspect has only been particularly described for specific cases and has not yet been systematically reviewed and generalized, we set out to synthesize a theoretical framework for Freinet pedagogy in IT-supported higher education settings in the first part of the article.

Based on the theoretical grounding, we form our course design for developing scientific working skills in the second part of the article. The evaluation of the design is carried out following an action research process as described by Susman/Evered (1978). We report on three design iterations that were developed and tested in 12 instances of the course design overall. We then discuss the potential of using Freinet concepts for the aim of the present research, and set out to identify the implications for course design, curriculum design and higher education in general.

3. Background on Freinet Pedagogy

So far, no comprehensive overview about how Freinet principles can be deployed in contemporary higher education settings has been made available. Furthermore, the amount of work reporting on how Freinet pedagogy can be adapted and used in today's technology-supported learning settings is also relatively scarce. This section sets out to summarize the state of research in this field.

A structured literature review has been conducted to establish a body of literature. The educational database ERIC[1] and publishers' databases as indexed by

1 http://eric.ed.gov

Google Scholar[2] have been used as initial sources. In ERIC, titles, abstracts, and identifiers were searched for the term "Freinet" and "Ecolé moderne".[3] Results were checked exhaustively for relevancy to this article. In Google Scholar, an overview about available scientific literature on Freinet pedagogy in general was obtained by searching for "Freinet" and "Ecolé moderne" as sole keywords, where for both cases the first 200 hits were checked in detail. Subsequently, each of these keywords was combined with one or several of the following keywords to narrow results to the field of interest of the present study: "academia", "academic", "university", "higher education", "online", "internet", and "web". For second level search, the references in the identified articles were searched for potentially relevant further sources. In addition, the works of identified key authors[4], who have published extensively about Freinet and received attention in the scientific community (as measured by citation counts provided by Google Scholar), were checked for further relevant publications. In a third strain of literature search, practitioners' literature identified via references in scientific publications and/or via searches in Google Books was examined for relevant statements.

Of all identified articles, only those available in English or German were considered. Several potentially relevant articles – e.g., mentioned by Schlemminger (2002) – are only available in French, Spanish or Polish and could not be further considered due to a lack of language skills of the author. All remaining articles were checked for potential relevancy based on their abstracts. Duplicates (i.e., articles that were published in different versions) were removed. Overall, the search identified 34 original articles, book chapters or edited volumes, which either discuss the fundamental principles of Freinet pedagogy or its potential role in higher education, with or without the support of information technology. The following discussion of related work is based on these articles. The full bibliography can be obtained from the author upon request. The aim of the following section is not to compile a comprehensive description of Freinet pedagogy, but rather give a structured overview about the literature informing the research presented in this article.

2 https://scholar.google.at

3 Using the notion that is generally used in literature to the school concept proposed by Freinet

4 N. Beattie, H. Eichelberger, W.B. Lee, G. Schlemminger, J. Sivell

3.1 Freinet's life and pedagogy

The development of the principles and techniques of Freinet pedagogy is generally attributed to Célestine Freinet. Several authors, e.g. Schlemminger (2002) or Eichelberger (2003), note that the role of Célestine Freinet's wife Élise Freinet is generally underestimated in the perception of Freinet pedagogy. While Élise Freinet has proposed genuine pedagogical concepts (Schlemminger 2002), her impact on what is generally perceived as Freinet pedagogy remains unclear, but can assumed to be substantial (ibid.). This article thus considers the concepts of Freinet pedagogy as perceived today as a joint work of Célestin and Élise Freinet.

Most published scientific articles that describe the principles and techniques of Freinet pedagogy focus on Célestin Freinet. Legrand (1993) gives a brief account of the life of Célestin Freinet before describing Freinet techniques and discussing their relevance for contemporary education. Articles with a similar scope have been written by Lee (1984), Temple/Rodero (1995) and Acker (2000). The latter focuses on the political foundations that have informed Freinet's work. Those foundations can be found in Marxism – a connection that is also stressed by Schlemminger (2002) and Kock (2006).

In general, the biographical articles stress the importance of Célestine Freinet's experiences as a teacher in the remote French countryside (Lee 1984), his life-long critical distance to theory-driven, "academic" education (Legrand 1993), and – being born in 1896 – the political influence of the socialist movement (Schlemminger 2002). Élise Freinet is perceived to be more influential after the death of her husband in 1966, where she acted as the major proponent of Freinet pedagogy, interpreter of her husband's earlier publications, and was the main driving force behind the further development of Freinet-oriented techniques until her death in 1983.

3.2 Freinet pedagogy in contemporary educational settings

Freinet pedagogy initially was predominantly recognized in continental European countries, in particular in France (Lee 1984). The concepts were hardly perceived or implemented in English-speaking countries (Beattie 1998). Most contemporary scientific publications on Freinet pedagogy, although partially written in English, still stem from continental European countries. The body of literature on how Freinet pedagogy

can be deployed to contemporary educational settings mostly comprises articles written from a practitioner's point-of-view. Examples are the books published by Riemer (2005) and Hagstedt (1997).

One particular contemporary area of application appears to be (foreign) language learning. Schlemminger (1996) introduces a pedagogical design based on Freinet principles that should support foreign language learning in schools. Kuznetsova/Régnier (2014) report on a study conducted in the same domain and found Freinet principles to lead to increased motivation for learning as well as to greater student autonomy.

Other contemporary articles focus on the specifics of aligning the pedagogical principles with the national educational systems in different countries. Hansen-Schaberg/Schonig (2001) present an edited volume that contains several contributions to contemporary implementations of Freinet concepts in German schools. In a similar effort, Eichelberger (2003) presents an edited volume providing an Austrian and Italian (Southern Tyrolean) view on how Freinet pedagogy is implemented in these countries.

Freinet pedagogy is also frequently discussed in the context of reformatory pedagogics in general. Watling/Clarke (1995) discuss reformatory approaches with a focus on Freinet for early education. Eichelberger (1995) provides a structured review of Freinet pedagogy contrasted with the approaches of Hellen Parkhurst (Dalton Plan), Maria Montessori and Peter Petersen (Jena Plan). Purmann (2009) engages Freinet in a fictional discussion with Montessori and Petersen with respect to the envisioned role of reformatory pedagogics principles for schools in 2020. Pihlgren (2006) provides a discussion of Freinet principles in the context of John Dewey and Mortimer Adler (Paideia Program), and their implications for modern schools. All mentioned works take a narrative approach rather than qualitatively comparing the different concepts. This might be attributed to the lack of empirical evidence on the effects of implementing different reformist pedagogical approaches. Several of the above-mentioned authors stress that reformist pedagogics nowadays are mostly implemented by bringing together concepts from different original approaches.

3.3 Freinet pedagogy in higher education

The principles of Freinet pedagogy have been discussed for application in a higher education context by several authors in the last 20 years.

Rabe/Schlemminger (1999) present and discuss a comprehensive concept for implementing a Freinet-based seminar, but do not report explicitly on any lessons learned during implementation. Ubbelohde (2001) discusses the potential for Freinet-informed project-based learning in academic teacher education. Different class-based interaction settings are combined with working on a long-term project in groups. The same field is addressed by Bolland (2005), who does not focus on particular techniques but discusses, how a whole curriculum on teacher education could be designed based on the principles of Freinet.

Génevaux/Pelat (2012) describe a concept for autonomous collaborative learning in a university course context following rules based on Freinet pedagogy. Pyykkönen/Kalliomaa (2013) introduce a project-based learning method informed by Freinet principles and describe its application in a curriculum on sales management. The concept is based on collaborative writing in small groups that contains individual study phases followed by cooperative consolidation and synthesis of the individuals' contributions. Student groups are asked to identify their own research question based on topic areas specified by trigger sentences. Aleksander (2014) discusses how academic courses can be designed around the idea of collaboratively creating a book of practical value for the respective educational domain, where individual articles are created by small groups of students. He illustrates the concept on a seminar-like course implemented in a curriculum of pedagogy.

Summarizing, the application of Freinet pedagogy in higher education has mainly been discussed for course settings that are inherently collaborative and rely on active contributions of students (like seminars or study projects). Also, courses focusing on written work as their main output seem to have been perceived as suitable for enrichment with Freinet principles. Lastly, most practical evidence seems to stem from courses in the context of teacher education, which are often designed for facilitating reflective practice (Schön 1984), i.e., learning about Freinet pedagogy by reflecting on one's own experiences when being confronted with it.

3.4 Potential of IT usage for Freinet pedagogy

Biographies of Célestin Freinet claim that he – having died in 1966 and thus still having perceived the beginnings of the IT revolution – was interested in

new technological developments and open to incorporating them into his work-based techniques. More recently, several authors have discussed how web-based work and collaboration platforms could be used to implement Freinet-based learning approaches even in spatially and temporally distributed settings.

Sayers (1990) is the first to explicitly address this issue by discussing the potential of "computer-mediated writing networks", i.e., the computer-based exchange of text. These networks are used to implement the Freinet technique of "school correspondence", where publications of students are exchanged among schools and students' literacy development in general. Dillenbourg et al. (2002) discuss virtual learning environments as a platform for text production and mention their potential to support the implementation of Freinet techniques. Bronkhorst (2003) discusses the potential of networked computers for supporting students' writing and correspondence activities, which are emphasized by Freinet. He furthermore identifies the potential of the world wide web as a resource to be used for autonomous work and researching topics of interest during learning. Tavares (2005) identifies computer games and user-generated modifications in computer games as an instance of the Freinet principle of publicly documenting one's own creative work.

Eichelberger et al. (2008) discuss the use of eLearning platforms that enable students to work on content – by annotating and discussing it online – from the perspectives of several reformatory pedagogic approaches, among them Freinet. They stress the potential for collaborative activities but also identify the ability to individualize learning processes as a potential added value of web-based learning processes. Similar potential is identified by Escofet/Marimon (2010), who also emphasize the potential for collaborative work online.

Summarizing, the original Freinet principles appear to be facilitated or augmented by modern communication and publishing technology. Freinet pedagogy strongly focuses on documenting and communicating one's learning experiences and work (as discussed in the next section). Networked computers are perceived as an enabling technology that changes the way students can publish, document and disseminate their work among their colleagues and to a wider audience. The use of computers and the internet as creativity tools is also mentioned in several articles, but in general is positioned less prominently.

3.5 Summary

The body of available literature on Freinet concepts and their potential for adoption in contemporary educational settings in higher education in general is highly practice-oriented. It largely lacks empirical evidence on the effects of deploying Freinet concepts in general and in higher education in particular.

Still, the available reports on successful implementations in higher education appear to support the hypothesis that skill development in scientific writing in an autonomous and self-direct way can be facilitated by techniques of Freinet pedagogy. In particular, seminar-like settings based on individual and collaborative writing and inquiry in combination with technological support for communication and coordination among students seem to be a promising approach for achieving the aims of the present study. In the next section, we briefly introduce the fundamental principles and techniques of Freinet and subsequently discuss how they could be operationalized for the intended target setting.

4. Kernel Theory

This section gives a brief account of the concepts of the Freinets' pedagogical approach. It deliberately refrains from discussing its socio-cultural foundations and focusses on what literature has identified to be its core concepts. For discussions on the historical and socio-cultural background of Freinet pedagogy, readers are referred to Schlemminger (1999), Temple/Rodero (1995), or Lee (1980) for a more critical appraisal of Freinet pedagogy.

Freinet pedagogy is based on the assumption that education emerges from reflecting on experiences made in the course of interacting with the "real world" (in contrast to "artificial" school-based settings) throughout the process of productive work (Kock 2006). This has led to the formulation of didactical principles that are summarized in the following section. These principles are the foundation of a set of techniques that are devised to be embedded in the didactics of Freinet-based education. The techniques are presented afterwards. More extensive discussions can be found in related work as discussed above, e.g., (Legrand 1993).

4.1 Pedagogic principles

Freinet pedagogy lists five fundamental principles that learning should be based on. The following discus-

sion is based on the interpretations of Lee (1984) and Schlemminger (1999). The translation of the original terms to English is adopted from Schlemminger (1999). It is important to note that these principles were only explicitly described some 20 years after the concrete techniques described in section 4.2 were developed and deployed:

- *Pedagogy of Work* (Pédagogie du travail): Learning is based on practical work and not driven by theory. Students learn by making useful products or providing useful services to others. Work, as described by Freinet, encompasses both physical and intellectual activities, which cannot be separated from each other.
- *Co-operative Learning* (Travail coopératif): Learning takes place in a collaborative context and emerges from the interaction of students among each other and with the teacher. It is based on co-operation in the productive process.
- *Enquiry-based Learning* (Tâtonnement expérimental): Students learn empirically through personal experience in real-life situations by a kind of rudimentary problem solving or experimental groping. Learning is based on exploring a solution space for real-world problems experimentally by trial and error involving group work.
- *The Natural Method* (Méthode naturelle): Learning is based on an inductive, global approach. It is always situated in the students' current living situation. Here life is conceived as a broad concept including nature, nature by itself, and the social and political aspects of contemporary life.
- *Centers of Interest* (Complexe d'intérêt) - Learning is based on students' learning interests and curiosity. Students within the context of the school and in alignment with others choose themselves what to work on and how to explore their topic of interest.

4.2 Techniques

Freinet pedagogy proposes several techniques that support the implementation of the principles described above (Schlemminger 1999).

Many of the proposed techniques center around the topic of writing, printing and publishing. The *Learning Printing Technique* is often perceived as a cornerstone of Freinet pedagogy. Following the work-based approach to learning, students use a printing press to reproduce texts that they have composed freely. In manually compiling the letters to form words and sentences, an immediate, "tangible" understanding of syntax and semantics should be facilitated. *Free Writing* is another cornerstone of Freinet pedagogy, aimed at enabling students to focus on their centers of interest and allowing them to verbalize their experiences from their daily life (following the principle of the natural method). Students are asked to write down their own personal adventures, or incidents that they have had experienced inside and outside school. To integrate cooperative learning, the individually created texts are presented to the whole group, discussed and/or edited there, and then finally printed by the students themselves. This concept was eventually extended to publish collections of the created texts as *Class Journals* and *School Newspapers*. Going beyond the borders of single schools, *School Correspondence* is used to exchange printed materials among spatially distributed groups of students or whole schools.

Students are provided with free access to a *Class Library*, assembling documents, files, books and other materials on relevant topics to aid individual learning processes around their own centers of interest. This can also include materials created by the students themselves during their work, which is referred to as a *Working Library.* Engagement with different topics is facilitated by prepared environments, called workshops or *Ateliers*, which offer materials, tools and tasks to engage with the particular topic of the atelier (Legrand 1993). To facilitate autonomous learning, the tasks are augmented with *Self-Correcting Files* where possible (ibid.).

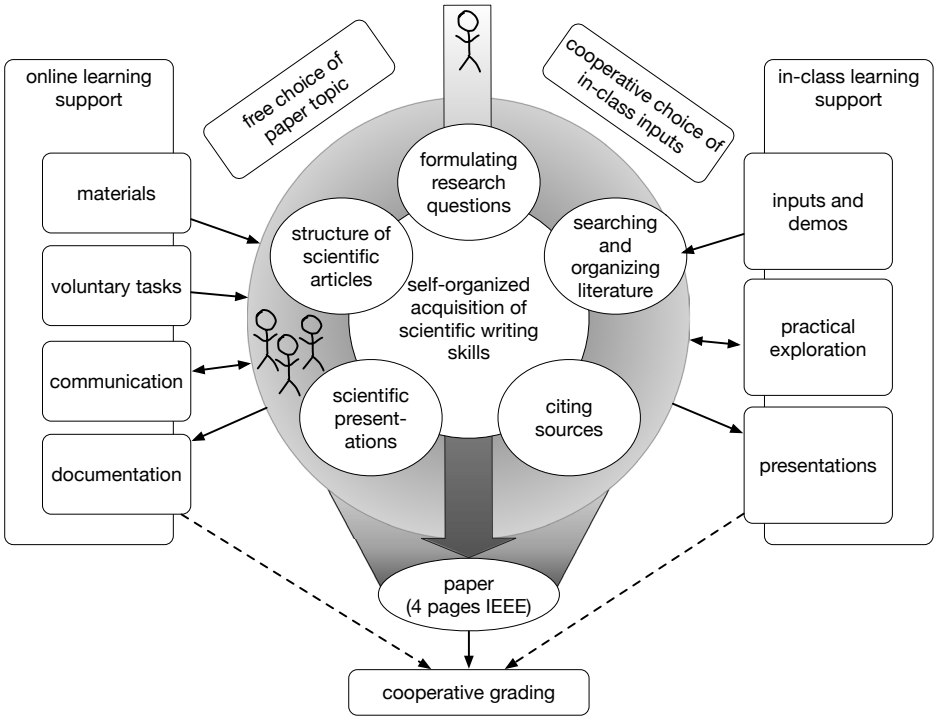
Freinet pedagogy encourages students to conduct their own *Field Investigations* and research to aid enquiry-based learning. Students regularly observe and study their natural environment and local community. Back in class, they use the writing and printing techniques presented above to reflect on their findings.

In terms of the institutional scope of learning, Freinet pedagogy focuses on students' self-organization on an individual and collective level. Each student develops an individual *Work Schedule*, which is discussed and evaluated with the teacher. The co-ordination of activities, and any problems affecting individual students or groups are regularly discussed in the *Classroom Assembly*, which consists of all students and the teacher. Work results and the progress of the whole group of students are documented in the class journal.

5. Course Concept

For the present research, the pedagogic principles of Freinet have been applied to a single course in a bache-

Figure 1: Global course concept



Source: own illustration

lor curriculum of business informatics ("Wirtschaftsinformatik"). This limits the comprehensiveness of the applicability of both the principles and techniques, as they in part rely on being embedded in an institutionalized setting. These limitations are discussed at the end of this section.

The course used for implementing the didactical principles is a "proseminar". "Proseminars" focus on introducing students to the fundamentals of conducting research, in particular scientific writing. In the overall curriculum design, proseminars are intended to be taken in preparation of writing a bachelor's thesis. Students must complete two of four offered proseminars. Each proseminar has a genuine scientific focus derived from the research of the department it is offered by. The proseminars also differ in their didactical approaches, which are made transparent to students via syllabi upfront before registering. Therefore the participants deliberately and voluntarily chose the proseminar discussed here.

5.1 Global Course Design

Students' activities in the course follow the principle of self-organization. Aside the formal aims of the course as described in the curriculum, the syllabus sets forth the additional aim of supporting the development of a self-directed, creative way of scientific working.

Students are provided with the syllabus that outlines the course objectives and didactic concept, and are given access to content and instruments that could help them achieve these aims. Choosing how to achieve such aims is the students' responsibility. The learning environment provided in the course is outlined in Figure 1. We discuss the components shown there along the fundamental principles of Freinet pedagogy in the following sections.

The course contains seven in-class sessions, each of which last around three hours. They are split into two parts: the first part with mandatory attendance is used to answer administrative questions and make announcements, discuss topics concerning the whole group, and provide room for presentations by students. The second part is voluntary and covers learning-centered activities as listed in the left-most box in Figure 1. They are discussed in more detail in the following.

The course is accompanied in an online collaboration platform. The course concept requires means for publishing learning materials, announcements and maintaining discussion forums. Furthermore, it requi-

res enabling students to publish documents. Learning platforms[5] or project management tools[6] have been successfully deployed for this purpose. The use of this platform is also discussed in more detail below.

5.2 Adoption of Freinet Pedagogy in the Course Design

The course design follows the principles and several of the techniques originally conceived in the works describing Freinet pedagogy. We discuss the design structured along the principles in the following section. Further, we describe the deployed support instruments, give an account of the necessary interpretation and adaptation from the originally devised Freinet techniques, and discuss the encountered limitations.

5.2.1 Pedagogy of Work

The course design is fundamentally based upon a *pedagogy of work*, fully focusing the process of creating shareable artifacts (in this case: scientific articles, presentations, materials created while practicing). It considers traditional teaching inputs as only one means among others that can be used by students to gather information necessary to complete their work.

The students are responsible to assess their individual needs developing skills in the different aspects of scientific working. Operatively, this is supported by the technique of the *work schedule* which is implemented in a forum in the online platform where students commit to complete learning and/or working tasks. This commitment is visible for all participants and thus is not only used for documentation but also to encourage cooperation among students committing to the same tasks in the same timeframe.

Students must commit themselves to complete the tasks they select at the end of each in-class session. While they are free to choose to not complete any task, failure in demonstrating the required skills in the paper in combination with a lack of respective tasks is a factor that is considered during assessment of the achieved learning goals. Students use the collaboration platform to document the work they have conducted for the course. This is implemented in the form of an individual learning diary accessible to all students and the teacher.

During in-class sessions, students are free to individually or collaboratively work on self-selected tasks to practice their skills in different areas of scientific working (as described in the center of Figure 1), or continue to work on their article. The teacher remains available for questions or as a facilitator if required.

5.2.2 Centers of Interest

The principle of *centers of interest* is addressed in the course concept by asking students to select a paper topic that they are genuinely interested in. Students are responsible for choosing their own paper topic themselves. All students write a paper alone and as an individual process.

This approach resonates with the ideas of the *free writing* technique, which should enable students to focus on developing writing skills rather than being disturbed by some artificial topic constraints.

The development of the work schedule is informed by the offered prepared tasks that follow the idea of *self-correcting files*. Their form of presentation is not described in detail in Freinet pedagogy. The approach chosen here is close to what the Dalton Plan proposes for describing "allotted tasks" (Lynch 1924). The tasks are organized in virtual *ateliers* structured along the topics given in the center of Figure 1.

An atelier is a prepared learning environment, which contains learning content on a particular skill (i.e., links to the working library) and tasks that help to practice this skill. Ateliers are made available via the online collaboration platform.

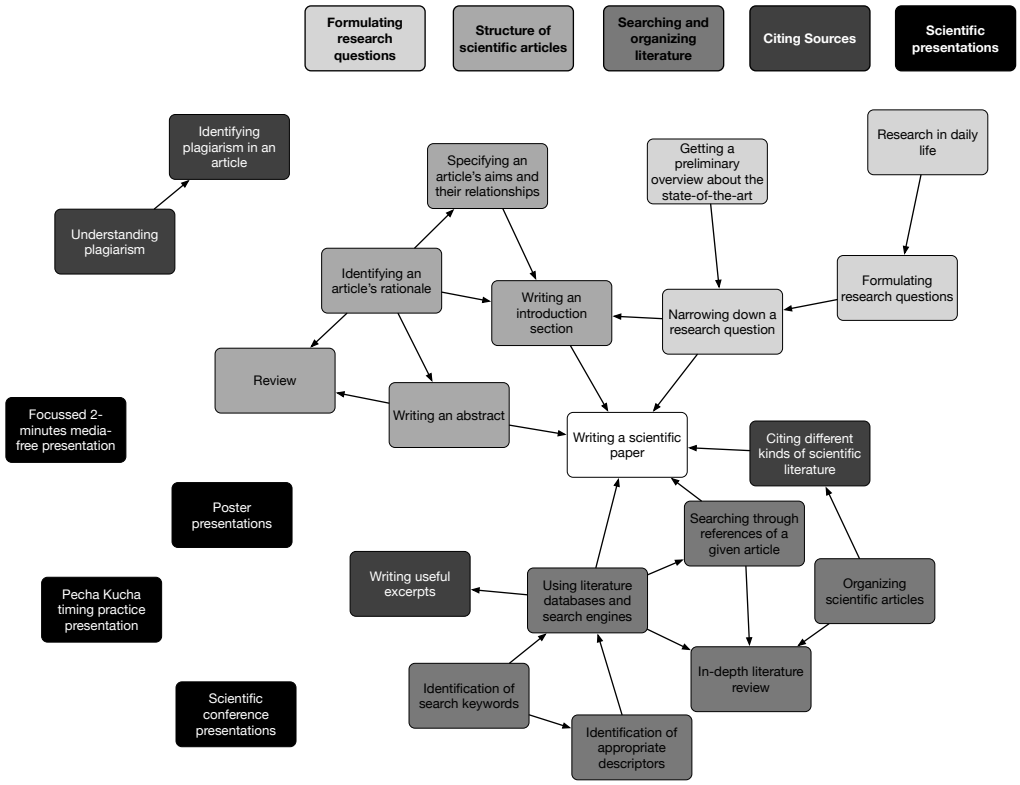
Tasks are described using a uniform template. In the following, we show a sample task described using this template.

```
Searching through references of a given article
-----------------------------------------------
Aim: You know the meaning of the term "backward
literature search" and are able to conduct a
backward search for your topic using litera-
ture search engines and databases.
Required skills:
 - Using literature databases and search engi-
nes
Recommended documentation:
 - Identify articles
 - Document literature search
Estimated time effort: three hours
Self-correction: compare your identified artic-
les with those identified by colleagues from you
```

5 Such as Moodle, https://moodle.org

6 Such as Basecamp, http://www.basecamp.com

Figure 2: Atelier tasks and their dependencies



Source: own illustration

```
learning group; optionally, also discuss your
results and search process with the teacher
Inputs:
 - Slide set "literature search"
 - Video recording "search strategies"
 - Book, "The craft of research", ch. 5, sec.
5.5
```

The template's fields not only allow for a description of the task itself, but also outline its aims, the required skills (by referring to other tasks) and other meta-information, such as estimated time effort or means of self-assessment. For each task, pointers to relevant learning materials in the working library are provided.

Students are provided with a graphical overview of the dependencies among the available tasks (cf. Figure 2). This enables them to assess those tasks they might consider to complete and those they do not consider relevant to their aim.

5.2.3 Enquiry-based Learning

Enquiry-based learning as a principle is picked up in the process of writing the scientific paper in respect to both the content of the article and the necessary steps to create a well-written article. The content of the article is designed by students by what Freinet would call *field investigations*, which – due to the scope of the course – students mainly perform in online and physical scientific literature libraries and – depending on their chosen topic – also in specific fields of application (e.g., when comparatively assessing a selection of social media tools with respect to a given set of properties).

Students can request inputs from teachers on topics they consider relevant to complete upcoming tasks. Teacher inputs can take the form of presentations, interactive demos or guided exploration. Potential teacher inputs to choose from are announced via the online platform. Students can also request further input on other topics. Additional learning and reference material is made available via the online collaboration platform. These materials comprise written introductory notes, slide sets, relevant book chapters, etc. (*class library*). In addition, students' self-created materials are also made available (*working library*).

The opportunity to individually discuss intermediate versions of the paper with peers and the teacher also contributes to this principle. The online platform is used as a publishing channel for draft versions of stu-

dents' papers. As part of the atelier on "structuring scientific articles", students are free to agree upon mutual review of their work. Furthermore, they can request individual feedback by the teacher on an intermediate version of the paper. These feedback channels leave room for experimenting with the structure and content of the paper throughout the course until the final discussion of the result (i.e., the final paper).

5.2.4 Co-operative Learning

The principle of *co-operative learning* is embedded in the course design by asking students to form small working groups supporting each other in acquiring the necessary skills to complete their writing task. Students are responsible for organizing themselves in small working groups (two to four students) to support each other in acquiring the necessary skills to complete their writing task.

The organization of these groups and their communication is facilitated by the online collaboration platform and free working time during in-class sessions. The online learning platform provides content-oriented discussions that are primarily used by the students for mutual support. The teacher, who is committed to providing support when requested, monitors discussions.

Within in-class sessions dedicated to discussing problems and planning further steps, time slots facilitate whole class coordination. These time slots provide an open communication forum that is not constrained to organizational or administrative issues but can cover any aspect relevant to the course. A forum in the online collaboration platform used to plan teacher inputs and student presentations in in-class sessions is used for this purpose. The combination of these two instruments enables implementation of the Freinet technique of *classroom assembly*. The results of free writing and other completed tasks are shared via the online collaboration platform and can also be collaboratively discussed and edited there (e.g., in the form of mutual review). In this sense, the platform also takes the role of a *class journal.*

The results of the course are not shared beyond the group of participants; thus, the techniques of *school newspapers* or *school correspondence* are not currently addressed.

5.2.5 Natural Method

The *natural method* is a principle that is hardly considered in the course design. It is visible in some atelier tasks concerned with practicing presentation techniques and obtaining a fundamental understanding of research in general. In some of the tasks in these areas, students are explicitly asked to not focus on any prescribed scientific topic, but explore or present aspects of their daily life.

The essence of the *learning printing technique*, namely the tangible engagement with text to produce sharable artefacts, is also hardly addressed in the presented course concept. Still, students are encouraged to not write their texts in desktop publishing software like Microsoft Word, but use low-level typesetting software, such as the LaTeX-system, that provides a more thorough insight into the process of text layout.

6. Evaluation & Evolution

The course concept has been instantiated each term since its initial design in 2011. The design-science-oriented research approach (Collins 1992) calls for an evaluation of the conceptual design derived from theory and the development of design iterations based on the empirical findings. This evaluation has to "[focus] on the design and testing of significant interventions" (Anderson/Shattuck 2012), i.e., the deployment of concepts and instruments oriented on the Freinet principles, which "need to be situated in a real educational context" (ibid.), i.e., assuming that the work-based and enquiry-oriented foundation of the course can only be effectively studied in a real world context.

As already briefly discussed in section 2, these demands on the empirical evaluation can be met by an action-research-based study (Venable 2006). Following the research model outlined by Altrichter et al. (2002), we describe the research questions and deploy data collection methodology in the following:

Action research follows a spiral model in which each cycle consists of phases of planning interventions, acting in practice, observing effects and reflecting on them with respect to the aims that should be pursued. Overall, three-action research cycles were carried out. The "acting" phase for each cycle lasted four terms (i.e., four courses were implemented without changing the concept) to account for variances in the student population and maturing of potentially newly created materials and/or support infrastructures.

In line with the global aim of this article, the reflection-phases of each cycle in an action research study need to focus the following *research questions:*

RQ1: What are the effects of the course design on the ability of the students to deploy scientific working techniques when working on own research problems?

RQ2: What are the effects of the course design on abilities to approach research tasks in a self-directed, creative way of working?

In case undesired effects are observed, i.e., the intended outcomes are not achieved, the course design needs to be adapted and evaluated in another action research cycle.

The following *data collection methods* were deployed to assess these questions during reflection:

The main data source relevant for both research questions is observation of students' use of the offered support instruments as described in section 5 (e.g., learning materials, self-correcting files, in-class inputs, etc.). These data comprise observations from in-class sessions made by the teacher as well as log-data generated by the learning platform on the use of online features, and information on the students' learning and work process as documented themselves.

The main data sources relevant to assess the effects asked for in RQ1 are the documented results of the course (i.e., the final paper and — if available — intermediary versions). The teacher analyzed strengths and shortcomings with respect to structure, line of argumentation, formal adherence to formatting and citation guidelines, and the used literature sources. In addition, students' activities related to acquisition of skills in scientific working techniques (i.e., completion of self-correcting files, in-class group activities) have been observed with respect to the achieved quality of work results.

The effects addressed in RQ2 are discussed based on data generated from feedback by students and the review of activities students planned and carried out in the course. Feedback has been collected in each final in-class session from group discussions as well as from individuals during the final discussion of the written paper each student carried out cooperatively with the teacher to complete the course. Feedback of the students was structured along the following topics: the perceived added value they gained from participating in the seminar, perceived usefulness of the deployed support instruments, and ideas for further evolution of the course. The activities of students were also reviewed as part of the final discussion with respect to the process of finding and shaping their research questions, and the process of organizing the paper writing process and all connected tasks.

In the following, we briefly summarize the data collected in each cycle, its interpretation with respect to the research questions, and the changes to the course concept made based on these interpretations. Detailed data cannot be presented here for reasons of space, and can be requested from the author.

6.1 Cycle 1: Term 1-4

The original concept as described in section 5 was implemented unaltered in four instances from 2010 to 2012. Overall, 69 of 86 registered students successfully completed the course. The remaining 17 students dropped out of the course for reasons not further examined.

6.1.1 Observation

Student use of the offered support instruments: The most prominent observation was that the self-correcting files in the ateliers were hardly used (of 69 students, only 13 documented the completion of at least one self-correcting file). Students attributed this to their voluntary nature and the workload resulting from other courses. Furthermore, the possibility for collaboration with peers was hardly used, as was the opportunity to voluntarily collect feedback on one's own writing from peers or the teacher. Collaborative course planning was also barely used because students often felt overcharged with selecting appropriate teachers' inputs for in-class sessions due to lack of knowledge about what would be important for their next steps.

RQ1: Fifty-eight percent (n=40) of the articles initially submitted by students as their final work did not reach the minimal aims of the course in terms of structure, line of argumentation and foundations in literature. Twenty percent (n=14) of the articles showed weaknesses in at least one aspect but were acceptable. Twenty two percent (n=15) of the articles basically met the requirements of a scientific article with no or only minor issues. Seventy-two percent (n=50) of the students chose to resubmit revised versions of their articles after discussing potential improvements. After the revision, 43% (n=30) of the articles met all requirements, 38% (n=26) had minor shortcomings (i.e., had weaknesses in one criterion at maximum), 14% (n=10) had major shortcomings (i.e., had weaknesses in two or more criteria) and 4% (n=3) still failed to meet the requirements (i.e., did not meet the minimal requirements in at least one criterion).

RQ2: The most often mentioned positive aspect in student feedback was the freedom of topic choice. Selecting a topic of one's own interest was highly valued and perceived as the most important added-value of the course. Furthermore, the extension of the course beyond its core topics by giving students the opportunity to give oral presentations on topics stemming from personal context was very well received. Still, about 30% of student stated in the final discussions that they hardly performed any work dedicated to the course for largest share of the term and then wrote the paper in the final week, again attributing their behavior to the workload resulting from other courses. This feedback is in line with the observations of the teacher on the learning and work process, which showed little activity of the students during most the course with higher activities on topic clarification and writing in the two weeks before the final discussions.

6.1.2 Reflection

With respect to RQ1, the course design could only partially reach its aim to develop students' abilities to deploy scientific working techniques when working on own research problems. The major shortcoming seems to have been that students did not use to opportunity to collect timely feedback on their writing results. After they had received feedback and revised their articles accordingly, most could meet the aims of the course.

With respect to RQ2, both observations and student feedback showed that the aim of facilitating creativity in scholarly activities (i.e., topic selection, presentation of results, etc.) was met. A sufficiently refined and planned self-directed way of working could only be observed in individual cases. Students attributed this to outside time pressure (i.e., by work to be completed for other courses, or professional activities) and to feeling overwhelmed in selecting the required support measures.

Findings with respect to RQ1 and RQ2 seemed to indicate a need for stronger guidance throughout the course. This was implemented in the second design iteration as described in the following section.

6.2 Cycle 2: Term 5-8

Based on the results of the first instantiations of the course, some of its elements were redesigned. Redesign was generally characterized by a reduction of students' freedom with respect to the organization of the learning process and an increase of guidance measures. Overall, 58 of 72 registered students successfully completed the courses following the new design. The remaining 14 students dropped out of the course for reasons not further examined.

6.2.1 Planning

The following changes were made to the course design: The teacher scheduled teacher inputs on fundamental topics of scientific writing for presentation in particular in-class sessions. Still, attendance remained voluntary. The self-correction files in the ateliers were still provided, but not positioned prominently. Mandatory publishing of the individual work plan was omitted and replaced by explicit discussion sections on writing progress in-class and in the online platform.

In terms of guiding the writing process, the chosen topics of the articles had to be publicly announced in the first month of the course. Mandatory intermediate talks were introduced with the requirement of having at least written a draft of the introduction and an outline for the remainder of the article, including literature. Furthermore, mandatory peer review was introduced. The learning diaries were removed from the course and substituted with individual reflection during intermediate and final talks. The remainder of the course remained unchanged.

6.2.2 Observation

Student use of the offered support instruments: The more structured process with pre-specified, mandatory deadlines in general led to higher student activities. More content-centric collaboration than in cycle 1 could be observed in discussions in the online platform and during in-class sessions. This was indicatively caused by the public announcement of selection topics, which increased awareness about potential collaborators. The peer review process could be implemented as planned and further extended cooperation among participants.

One unanticipated effect of the changes was that the number of students leaving the in-class sessions after the part with mandatory attendance rose. When inquiring about the reasons, students stated that they gained little value from the inputs provided in the part with voluntary attendance, as they did not match their individual progress in paper writing.

RQ1: The changes in procedural guidance led to a reduction of approx. 10% of the number of people not

achieving the minimal aims of the course when submitting the initial version of the paper. Student feedback and the results of the final discussions showed that the mandatory peer review generally improved students' understanding of paper structures and writing constructs. Of the final submissions, 53% (n=31) fully met the requirements, 36% (n=21) showed minor issues, 7% (n=4) had major issues and 3% (n=2) failed to meet the minimum requirements of the course.

With respect to the now mandatory intermediate versions, 21% (n=12) submitted a content-wise elaborated version, whereas 43% (n=25) provided an outline and an initial version of the introduction (i.e., the minimum requirement) for the discussion. The remaining 36% (n=21) failed to initially provide an outline of their selected topic and took another iteration in the structuring process after teacher feedback.

The documented peer reviews in general were conducted thoroughly, consistently showing that students had understood the fundamental structure of a scientific article, could identify the relevant building blocks in their colleagues' writings, and — in about 2/3 of the cases — pointed at issues that were also identified by the teacher in the intermediary discussions.

RQ2: The more explicit guidance measures led to reduced demands on self-directed work planning by students. Participants now had sufficient time to proceed through their work process step by step with intermediate feedback and reflection cycles. This exposed an issue that had not become visible in the first cycle: Students frequently indicated that they felt overwhelmed with specifying their topic of research in a way that it could be appropriately dealt with in the limited space of the paper. Consequently, they would have preferred more individualized guidance throughout the writing process, receiving input appropriate to their progress and skill level.

6.2.3 Reflection

With respect to RQ1, the course design removed or altered some elements that were explicitly designed as contemporary instantiations of Freinet techniques. The deployment of stricter guidance measures without considering individual student's needs in particular counteracts Freinet principles. Still, the results improved (although not statistically significant) and more students finished their work within the course without the need for an ex-post revision. The reduction of students' freedom seems to have led to higher effectiveness of the remaining, unaltered elements of the course design, such as collaborative work on common research topics and peer review.

With respect to RQ2, no changes in the effects on facilitating students' creativity could be observed in contrast to cycle 1. Self-directed work planning was not improved, but the lack thereof was compensated for by stricter guidance measures. While students did not perceive the explicitly set deadlines negatively, they felt that content-oriented support measures (such as in-class tutorials) at least in part did not meet their individual learning progress.

More individualized learning support was introduced in the third design iteration as described in the following section in order to compensate for this issue.

6.3 Cycle 3: Term 9-12

The third iteration of the course was designed with the objective of improving individual student's teacher support. Focus was put on providing more room for individual discussions with each student, which was compensated for by a reduction of the amount of time used for teacher inputs in the plenary. Overall, 69 of 88 registered students successfully completed the course. The remaining 19 students dropped out of the course for reasons not further examined.

6.3.1 Planning

The following changes were made to the course design: An additional individual meeting with the teacher was introduced in the first weeks of the course for discussing a student's topic selection. Students now had three individual discussions with the teacher, each with a defined work result to be discussed. The aim of the first discussion was to condense the personal interests of the students to a topic sufficiently focused to be worked on in their course. The in-class inputs for the whole group of students were reduced and limited to core topics (structure of paper, literature search, writing an introduction) — the remainder of inputs were delivered as video recordings or provided to students following their individual needs during mentoring discussions.

6.3.2 Observations

Student use of the offered support instruments: Most students requested feedback on their intermediate work results in the individual support discussions. In

addition, student feedback indicates that the need to explicitly deliver intermediate results provided more structure in the overall work process, making sufficient time to work on the article more likely.

Students made frequent use of the inputs provided as video recordings of presentations. Access analytics and student feedback indicate that such input was more frequently used than written material (as already provided previously as part of the class library). Login statistics for the learning platform show that some students, who had already completed the course, kept coming back to the class library for reference, e.g., when writing their bachelor's thesis.

The observable use of means for discussion with peers (in-class or online) declined again in cycle 3, with most students focusing on collaboration with the teacher than with colleagues.

RQ1: The quality of results in general has improved; the number of students not reaching the minimal aims of the course with their initial submission, however, remains at 5-10%. Of the final submissions, 55% (n=38) fully met the requirements, 33% (n=23) showed minor issues, 10% (n=7) had major issues and 1% (n=1) failed to meet the minimum requirements of the course.

The requirement to already discuss the research question and its rationale as an initial work result further increased the number of students, who delivered content-wise elaborated article drafts as their intermediate work results, to 49% (n=34). The number of students failing to meet the minimum requirements on the intermediate versions was reduced to 17% (n=12).

RQ2: Student feedback has shown that the shift towards increased individual support reduced the feeling of being overwhelmed by certain aspects in the writing process. At the same time, the option to autonomously watch recorded teaching inputs was positively received. The issue of inputs not matching the individual learning and working process was not mentioned in the feedback for cycle 3. Working collaboratively with the teacher to identify the research topic was also noted as a positive aspect several times, and seems to have retained one of the original strengths of the course, namely to aid creativity in topic selection, while providing sufficient support to organize one's writing process.

6.3.3 Reflection

With respect to RQ1, the deployment of support measures more explicitly targeting individual learning processes – in combination with augmenting the class library with video recordings of teachers input – marks a move back towards a course design more in line with the original concept of Freinet pedagogy. The re-extension of student freedom to self-organize one's work (in contrast to cycle 2, but under more explicitly specified constraints than in cycle 1) did not have any statistically significant impact on the working results (which have still slightly improved in contrast to cycle 2). The observation of cases, were students came back to consult provided materials also after the course, seems to indicate that awareness of the potential relevancy of the course content has improved.

With respect to RQ2, the self-directed work planning of students seems to have improved in contrast to cycles 1 and 2. The guidance provided by the expected intermediate work results appear to have had a positive impact on student awareness of the required skills in the different work phases and on scheduling of activities. At the same time, the more individualized learning and working setting with frequent discussions with the teacher seems to have reduced the perceived need to collaborate with peers; this is an unintended effect that should be addressed in future iterations of the course design.

6.4 Concluding Reflection

The course design reported on in this article underwent three iterations. As has been argued in the design reflections above, the changes in the iterations were not driven by the requirement to reach a more comprehensive implementation of Freinet principles in contemporary academic teaching. Rather, the changes were based on identified shortcomings of the prior design iterations with respect to the aims of the course, namely to facilitate the development of the ability to deploy scientific working techniques when working on own research problems, and the development of abilities to approach research tasks in a self-directed, creative way of working.

This concluding reflection over the three design cycles consequently now aims at discussing which elements of the final design and which changes over the design cycles are still in line with the principles of Freinet pedagogy. We therefore revisit the Freinet principles originally used to structure the description of the course design, and discuss how they have been addressed in the different design cycles. We also reflect on our findings in light of results identified in related work in the field of Freinet-based academic teaching.

Pedagogy of Work: Focus on having each student produce self-created work results has remained unchanged over the design iterations. Experiences from the first design cycle had shown that students felt overcharged with being responsible for autonomously creating their own work schedule. Students also prioritized parallel courses with strict deadlines, leading to problems with finishing their required work results on time. These issues were addressed in cycle 2 with teacher-driven scheduling of activities and deadlines for intermediate work results — both measures arguably counteract the Freinet principle of self-responsible working. While the work results improved, students' initiatives for self-directed planning and scheduling vanished. In cycle 3, student autonomy was strengthened again by leaving them more room for individually planning and carrying out the writing process, but requesting three discussions with the teacher on intermediate work results. This is in line with the work schedule technique of Freinet, where work is discussed and evaluated together with the teacher (Schlemminger 1999).

Centers of Interest: The fundamental principle of letting students individually choose their own research topic according to their interests has remained unchanged over all three design iterations (in line with what Ubbelohde [2001], Pyykkönen/Kalliomaa [2013], and Aleksander [2014] present as a central property of Freinet-based academic teaching). Providing self-correcting files and learning materials as a central means for autonomously selecting and conduction learning tasks in line with one's own perceived needs for further skill development has shown not to lead to the intended effects in cycle 1. While the self-correcting files are still provided, they are no longer prominently positioned in the course design from cycle 2 on. With respect to the possibility to work on individual skill development, the self-correcting files have been replaced by more frequent individual discussions with the teacher in cycle 3 (after the lack of individually planning one's learning tasks had been identified as a deficiency in cycle 2). This leaves room for autonomous decisions on which tasks to further work on, and still creates a stronger commitment to perform the tasks, as they are agreed upon with the teacher.

Enquiry-based Learning: The research process necessary to find or gather the information required to write the article inherently is an enquiry-based learning process as described by Freinet. Both the process of finding relevant information and making sense of it in the context of the research question, however, require skills that need to be developed in the course. If support to develop these skills is not sufficiently structured (as observed in cycle 1), inexperienced students are prone to feel overwhelmed. This feedback is in line with Kirschner et al. (2006), who state based on empirical results that only if "learners have sufficient high prior knowledge that provides 'internal' guidance does the advantage of guidance begin to reduce". Cycles 2 and 3 deployed different approaches of providing more structure when assessing the potential relevance of support measures such as the class library or peer review. The individualized guidance measures deployed in cycle 3 here seem to have been more effective with respect to facilitating an enquiry-based learning process than the pre-structured delivery of learning inputs used in cycle 2.

Co-operative Learning: Cooperation among students in their working and learning process has been one of the initial design principles of the course. However, the lack of structuring elements in the working process in cycle 1 seems to have prevented co-operative learning activities to emerge (as a large share of students shifted their activities towards the end of the course and consequently ran out of time). The stricter guidance in cycle 2 — despite its negative effects on the self-directedness of working — seems to have provided more room for cooperation among students, as research topics were specified earlier in the course and consequently made visible for potential collaboration with other students exploring relevant literature for similar topics. Observable cooperation with peers, however, vanished again in cycle 3, where the focus of cooperation shifted towards individual discussions with the teacher. Future design iterations of the course in this respect might benefit from group discussions including the teacher and students with similar topics.

Natural Method: What Freinet refers to as the natural method was hardly considered to be a core design goal of the course from cycle 1 on. With increasing maturity of the materials provided in the class library, most written notes or recorded lectures make explicit reference to the relevancy of the covered topics for a student's current study situation (i.e., usually having nearly completed their undergraduate studies and now having to select and work on their bachelor's thesis project). Three students of cycle 3 had participated in a pilot in which the proseminar was combined with work on their bachelor's thesis, thus more closely connecting their current study situation with the learning setting in the course. While the outcomes in terms of

skill development and ability for self-directed research planning were promising, this approach does not scale up to 20-30 participants. The course setting thus still must remain artificial with respect to its aims, i.e., is usually not motivated from student's own living situation, except if the student explicitly creates a connection via their chosen topic.

Overall, the principles of Freinet pedagogy could be implemented to different degrees in all three design iterations of the course. The latest iteration reaches the original aims of the course to a large extent, and still is oriented on the principles of Freinet pedagogy. In line with the findings of Ubbelohde (2001), it appears that the principles of Freinet pedagogy can be transferred to contemporary educational settings. Most of the techniques, however, need to be re-interpreted, given the time of their development and the societal and educational context of 70 years ago. Deployment of modern information technology appears to be an enabler and facilitator here, in particular for enquiry-based learning, as is also mentioned by Bronkhorst (2003). With respect to co-operative learning, our findings indicate that information technology is also an enabler, as stressed by Escofet/Marimon (2010) and Sayers (1990), but does not appear to facilitate co-operation — this still requires an appropriately organized learning setting that emphasizes the need to work together (e.g., as demonstrated in [Aleksander 2014; Pyykkönen/Kalliomaa 2013; Génevaux/Pelat 2012]). Finally, some principles of Freinet pedagogy can only be implemented when stretching their scope beyond a single course and implementing them on a curriculum- or school-wide level, e.g., as described by Bolland (2005). This in particular is important for aspects of co-operative learning and centers of interest that assume a group of learners working together independently of one single course. In the next section, we thus discuss the generalizability of our findings and their implications on curriculum design and organization.

7. Generalizability & Implications

This section discusses the generalizability of the findings in this article for other courses, and gives a brief account of the implications of our findings for contextual influence factors relevant to Freinet-based teaching in academia, i.e., curriculum design, university administration, academic policy, teaching faculty, and student participants.

7.1 Generalizability

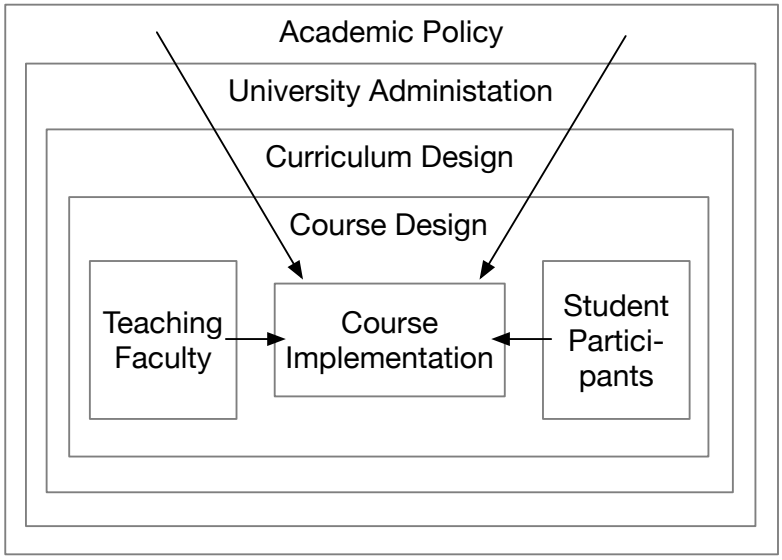
Design-science research usually ultimately strives to establish a design theory, i.e., a set of universally deployable principles that have been verified to solve the addressed design problem in different areas of application (Gregor/Jones 2007). The kernel theory of the present design is Freinet pedagogy. The findings from the action-research study described in section 6 show that the principles of Freinet pedagogy can be used for the specific aim of this article in the context of the curriculum the study was conducted in. Generalizability of the findings has not yet been conceptually addressed and empirically examined, and thus is subject to future research. However, given its topic-agnostic focus on developing writing skills, the course design should be transferrable largely unaltered to other educational domains.

For further generalization towards a theory on Freinet-oriented academic teaching, related work provides indications on which aspects need to be considered for designing courses in other contexts:

Writing to produce tangible results in a self-directed, collaborative and creative way is a core concept of Freinet Pedagogy (Schlemminger 1999; Rabe/Schlemminger 1999; Aleksander 2014). Aside from this, related work dedicating itself to implementing Freinet-based principles in academic teaching is rather selective in what it considers relevant to this respect (e.g., Pyykkönen/Kalliomaa [2013] stress the importance of project-based learning, i.e., puts a focus on the outcome of a project and its reflection, while Génevaux/Pelat [2012] focus on collaborative work on smaller tasks). These selective approaches appear to be deployable in a variety of domains and with different aims (e.g., (Pyykkönen/Kalliomaa [2013] show a practical application in Sales and Marketing, and Génevaux/Pelat [2012] have applied their concept for teaching fundamental concepts in engineering education). Approaches that consider Freinet principles more comprehensively have also been developed in different domains (such as Rabe/Schlemminger [1999] for foreign language education, or Aleksander [2014] for fundamentals in pedagogics).

The common principles these approaches share with the present research are their focus on letting students work to produce tangible outputs that document their learning process and result, and their focus on collaboratively working towards this aim with peers and a teacher. Freedom of topic selection, as deployed in the

Figure 3: Context of course implementation



Source: own illustration

present work, can hardly be found in related work. This might be attributable to the fact that the present work focuses on the development of transversal scientific working skills, which are largely domain-independent, and thus can be developed when working on arbitrary topics. In contrast, existing related work largely focusses on developing domain-specific skills or knowledge and thus constrains students in selecting what they want to work on.

Based on existing literature (Ubbelohde 2001), a generalized theory for designing academic courses oriented on Freinet pedagogy thus seems to require consideration of the originally proposed principles as a set of building blocks that are not necessarily taken into account during course design. One principle that can be found in any article in related work is to require results that students work on and finish in the course (*pedagogy of work*). Active, self-directed collaboration among students and with the teacher also appears to be a widely accepted and successfully deployed principle in academic teaching (*co-operative learning*). Orientation on exploratory learning processes and self-discovery of concepts can be found in fewer published course concepts and — if contained — usually focusses on exploring the existing body of academic literature on a given topic (*enquiry-based learning*). Freedom of choice when it comes the topic to work on (*centers of interest*) seems to be the most heterogeneously treated principle in existing literature. Its implementation is largely dependent on whether the learning aims address transversal (such as scientific writing or presentation techniques) or domain-specific skills and knowledge. The *natural method*, i.e., anchoring the learning topic in students' daily lives and discussing its social and political aspects, appears to be omitted in most course designs. This can be attributed to the constrained topical and organizational focus of single courses that hardly allows for addressing this principle. However, implementing Freinet principles on a larger scope could allow for more extensively considering them in course or curriculum design (Bolland 2005). This aspect is discussed in the following section.

7.2 Implications

Although freedom of academic teaching leaves room for experimenting with content and methodological approaches, single courses are embedded in the context of their curriculum, university and overall academic system (cf. Figure 3). These aspects impact the way course designs can be implemented by teachers and students (cf. Figure 3). The following paragraphs give a brief account of the implications derived from the findings in our study.

On the level of *curriculum design*, the results of the study in cycle 1 show that an orientation on Freinet concepts in single courses seem to lead to shifting students' foci to courses with more explicit structure and mandatory deadlines. The countermeasure in the current design has been a reduction of student freedom in work planning in the Freinet-oriented course. Extending the deployment of Freinet principles beyond single courses

to whole modules (i.e., a set of courses covering a single topic area in the curriculum) would not only allow for the reduction of competition for students' resources, but would also allow for a more in-depth implementation of Freinet principles, in particular those addressing student freedom in learning processes, such as "centers of interest" and the "natural method".

On the level of *university administration* and *academic policy* in general, the contribution to development of student knowledge on the work system level (Boreham 2004) and to the development of transversal competences for life-long learning (European Parliament 2006) – such as learning to learn, social competencies, or sense initiative – is positioned as a major aim for academic education. The European Qualification Framework[7] requires students from EQF level 6 and above (i.e., from bachelor level on) to show competence to "manage complex technical or professional activities or projects, taking responsibility for decision-making in unpredictable work or study contexts; take responsibility for managing professional development of individuals and groups".[8] Pursuing these educational aims is consequently expected from universities. Making them part of quality assurance evaluations for curricula and courses could broaden the field for open educational settings. Open learning settings in general have been shown to facilitate the development of such competencies (Giaconia/Hedges 1982). Freinet's focus on self-directed planning of learning processes and their collaborative implementation appears to have potential to further facilitate learning in this area (Pyykkönen/Kalliomaa 2013).

Working in an open learning setting poses different requirements on *teaching faculty* than traditional settings that should be incentivized by universities. For teaching faculty, open learning courses such as Freinet-oriented designs potentially require more effort in preparing and conducting teaching activities. Due to the need for all students to be individually supported in their specific learning processes, required teachers' inputs are not foreseeable and necessitate greater flexibility. Furthermore, due to the need for individual support, open learning settings cannot be scaled arbitrarily regarding number of participants. The teaching faculty thus potentially needs to collaborate closely during course implementation for working with higher numbers of students, which causes higher effort in coordination. Consequently, universities would need to adapt the metrics they use to assess faculty performance to provide incentives to invest sufficient time and effort in teaching.

Demands on *students* in open learning settings in turn are higher in terms of work planning, scheduling, and self-motivation. Even if curricula were designed in a way that avoids competing demands for resources between different courses, students still would need to make deliberate choices on what to work on, and individually choose their required means of support. Schools do not necessarily prepare students for these demands, so curricula would need to introduce students to the expected ways of working to achieve learning aims, and introduce the required competencies in an incremental process (Gudjons 2000).

8. Conclusion

This article has described a course design to facilitate the development of students' skills in scientific writing and inquiry based on the concepts of Freinet pedagogy. Its contributions have been twofold: first, the current state of discussion about the deployment of Freinet concepts in higher education has been comprehensively summarized in a structured literature review. Second, the course design and its evaluation over three action research cycles have been described based on a design research approach. They thus give an initial account of how Freinet principles can be considered in the design of higher education courses.

The study described here has several limitations. First, the design and implementation of the course has been driven and evaluated by a single researcher in the context of a single curriculum. To establish a more comprehensive set of experiences for future design iterations and eventually generalize the findings in a design theory, experiences from more diverse educational settings would be required. Second, experiences made during the course evolution indicate that concepts enabling individual mentoring and collaboration among students could further inform the implementation of Freinet-based learning settings. In particular, educational concepts like scaffolding (Van de Pol et al. 2010) or flipped classroom courses (Bishop/Verleger 2013) might inform future design iterations. In future research, we aim to explore the potential of these concepts and transfer our designs to other domains – such as information system design – and teaching formats – such as lectures and labs.

7 http://ec.europa.eu/ploteus/en

8 https://ec.europa.eu/ploteus/content/descriptors-page

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