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The Standardised Data Management Plan for Educational Research: an Approach to Foster Tailored Data Management

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Abstract

Although there is an increasing number of tools and support opportunities, research data management is still challenging. Conventional templates of data management plans (DMP) guide users, but hardly support them in implementing and realizing data management. Instead, users of conventional templates require more tailored guidance to better understand how to manage their data according to the needs of their research discipline, and its methods and practises, e.g., regarding data sharing. To provide more tailored, discipline-specific guidance, Science Europe (2018) suggests developing and using so-called Domain Data Protocols, i.e., a model DMP for a given discipline or community. The project Domain Data Protocols for Empirical Educational Research was one of the first to turn this concept into a practically useable DMP template tailored to educational research by developing the Standardised Data Management Plan for Educational Research (Stamp). The Stamp is designed to assist researchers in managing their data, appropriately, and to ensure shareable data according to the FAIR Data Principles. Due to its flexible structure, its checklist and auxiliary materials, the Stamp tackles most of the challenges of conventional DMP templates. Providing tailored, discipline-specific guidance and enabling to manage various types of data, the Stamp is an innovative approach to further professionalize data management.

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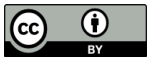

Introduction

In the past, research data management became of increasing importance. Nowadays, it is an integral part of good scientific practises, increasing transparency in research and fostering replicability of research outputs. Consequently, data management is required more and more often by different stakeholders in research, such as funding agencies, editors of academic journals or the research community, in general. For researchers, these developments are not without challenges, as they need to engage in various forms of data management. Data management can be quite time consuming, becoming a burden for researchers in temporary research projects. In addition, not every researcher has appropriate knowledge of data management, particularly in the early stages of their career (Bishop et al., 2023; Ashiq et al., 2022; Smale et al., 2020; Whitmire et al., 2015).

To assist researchers and data managers in planning and managing their data, a large variety of templates and guidance has been developed. One example are the various templates for data management plans (DMP), aiming to structure and support data management in a project. However, it can be challenging to choose an appropriate template that fits the specific needs of a particular project and the requirement of the corresponding research discipline. Because most DMP templates are quite unspecific, they do not consider the specific needs of a particular discipline and the data managed in it. Consequently, DMP templates are often criticized as being too structured to manage different types of data while lacking discipline-specific guidance and advice (Bishop et al., 2023; Ashiq et al., 2022; Lefebvre et al., 2020; Grootveld et al., 2018).

To provide more tailored guidance and to enable the management of different types of data, Science Europe (2018) suggests the concept of Domain Data Protocols (DDP), in terms of guidelines to manage data in accordance with the needs and requirements of a given community or discipline. The project *Domain Data Protocols for Empirical Educational Research in Germany* was among the first transferring this concept into use, developing the *Standardised Data Management Plan for Educational Research*, briefly called Stamp (DDP-Bildung & German Network of Educational Research Data, 2023). The Stamp is designed to face the various challenges of data management, to provide more tailored guidance, and to support researchers in processing Open Data, according to the FAIR Data Principles (FORCE11, 2023; Wilkinson et al., 2016) and the requirements of the educational research discipline.

In the current paper, we first outline challenges of conventional DMP templates, recapping the findings of former work on the use and usefulness of such assisting materials. In a second step, we introduce the concept of DDPs and provide an overview of the Stamp, its structure, and its various materials to foster data management. Finally, we discuss how the Stamp tackles most of the challenges of conventional DMP templates. We close with a short wrap-up on the advantages of the Stamp and its discipline-specific guidance on data management.

The Use of Conventional Data Management Plan Templates

Realizing the above-mentioned potentials in dealing with data – such as increasing transparency in the research process or improving the replicability of research outputs – usually requires the systematic implementation of (advanced) data management strategies throughout the entire research process. Accordingly, these are increasingly required by various actors in the research process. For example, funders usually require the data to be archived in a publicly accessible repository. Journals set rules for the handling of data regarding the reproducibility of research outputs, and professional societies develop recommendations for data management involving, for example, to enable an optimal reuse of data and a commitment to the transparency of science.

To be able to meet the various expectations and requirements, forward-looking planning is key, not least regarding the resources required for implementation. The challenge for

researchers is that DMP requirements often come with abstract descriptions and expectations (Bishop et al., 2023; Jäckel & Lehmann, 2023; Ashiq et al., 2022; Smale et al., 2020; Whitmire et al., 2015). Researchers need to determine what it means to meet the criteria in an efficient way and how they could be achieved in accordance with their discipline and topic-specific research methodologies and data. This can be confusing and off-putting – at least it is time-consuming.

The same challenge becomes evident in funding applications or when publishing results in a journal. Concrete reflection on data management issues is more and more often part of funding proposals or journal submissions, usually in the form of a DMP. In the DMP applicants describe how research data will be generated, processed, archived, and shared. However, guidance for the handling of data is often vague, including questions on general standards such as the FAIR Data Principles, (meta-)data formats or legal requirements hardly being familiar to researchers and reviewers (Lefebvre et al., 2020).

To address these challenges and to support researchers in planning their data management and creating the required DMP, many DMP templates have been designed in recent years (Bishop et al., 2023), e.g., by the European Commission for Horizon 2020 (European Commission, 2016), as one of the most important funding programmes for research and innovation in the European Union in the last few years. Such templates guide users through a variety of (potential) relevant data management topics providing questionnaires aiming at a certain level of standardisation in terms of structure and content. For example, the survey by OpenAIRE and the FAIR Data Expert Group (Grootveld et al., 2018) explored the useability and usefulness of the Horizon 2020 DMP template. As data management was mandatory in Horizon 2020 for at least some funded projects, the survey provides some relevant insights into the use of DMP templates in research projects. The results of the survey show, for example, that most of the respondents considered the Horizon 2020 DMP template to be very useful.

In other words, there is evidence that DMP templates offer a useful tool for raising awareness of several tasks and challenges of handling data among researchers. However, they do not function so well in supporting researchers to plan and implement concrete data management activities. Most of such DMP templates are generic, consisting of sets of requirements and questions on how data are processed and managed, asking, e.g., "What is the purpose of the data collection" or "How will the data be made accessible" (European Commission, 2018a). Users of such templates must figure out their own answers to plan, implement and realize their data management in a concrete and practical way. Moreover, DMP templates are rarely tailored to the respective substantive and methodological research context. Information on why certain activities should be considered at a particular moment is not conveyed, lacking guidance on, e.g., instruments, tools, or legal advice. In short, such DMP templates are written in a general way, not considering the specifics of a particular project, its data, and the discipline. Consequently, certain topics may not be covered sufficiently while others are over-specified for one discipline or another.

Asking the same researchers, who considered the Horizon 2020 DMP templates as useful, for a more detailed impression, they reported that additional support of local data management support teams, national data services or project officers was critical to complete the DMPs. This fits in with the survey's finding that the existing support and advice was often perceived as too general and vague. Looking on improvements, suggested by respondents, as well as on information and support lacking, it becomes clear that researchers "want much more tailored guidance and discipline-specific examples to help them apply the DMP questions to their context." (Grootveld et al., 2018, p.9). When asked about the lacking of guidance, the five most frequently mentioned desired additions were to include "best practise [guidelines], examples or references to an [example] DMP", to "provide subject-specific templates" and information on how to get further "information and specific guidelines for a certain field" (specific discipline), to include "information about costs" and noted that the included "guidance is too complicated, technical, vague or generic" (Grootveld et al., 2018, p.17). Consequently, the top five suggested improvements were to "suggest relevant standards for their [research] field and data types", to "provide more [DMP] examples and answers", "provide dropdown options based on good practice for their discipline", to "include disciplinary guidance and tailoring, and to recommend

"repositories [for data sharing] and tools" for data management (Grootveld et al., 2018, p.24). In short, users of Horizon 2020 DMP template required more tailored, discipline-specific guidance to manage their data professionally.

The Standardised Data Management Plan for Educational Research (Stamp)

To ensure professionally managed and accessible data as well as to provide more tailored, discipline-specific guidance, Science Europe (2018, p.9) suggests the concept of "Domain Data Protocol" (DDP), i.e., "generally agreed-upon guidelines, or predefined written procedural methods. One might also conceive a DDP as a 'model DMP' for a given domain or community that shares common methods." In contrast to conventional DMP templates, DDPs provide clear and accessible instructions and guidance on the various aspects that need to be considered in the entire process of data management. DDPs ensure professional data management along the data life cycle and foster data sharing, considering the FAIR Data Principles, as required, e.g., by concepts on FAIR implementation (Henning et al., 2021; GO FAIR FIP Working Group, 2020; Jacobson et al., 2020; Schultes et al., 2020; European Commission, 2018b).

Based on this concept, the project DDP-Bildung (Perry et al., 2022) developed the *Standardised Data Management Plan for Educational Research*, abbreviated to Stamp (DDP-Bildung & German Network for Educational Research Data, 2023). The project was carried out between June 2019 and May 2022 by staff members of twelve German research institutes, most of them involved in educational research, all of them involved in research data infrastructure.[1]

Educational research is characterised by a common set of methods of data processing, such as collecting, analysing, storing, or sharing data. Target groups of educational research are often vulnerable research populations, such as children or teenagers. The research process usually faces legal restrictions, data protection and ethical aspects. Moreover, educational data are heterogeneous, covering a large variety of different types of data. They can be standardised surveys, observations, text documents, documented examinations, videos and audio records, gathered, for example, online, by personal interviews or group discussions.

The project DDP-Bildung aimed at developing a tool taking all the different needs and requirements of educational research into account. To our knowledge, no other DDP was realized in any discipline at the beginning of the project.[2] By applying Science Europe's concept of DDPs, we started with transferring the concept of Domain Data Protocols into practical use. To ensure meeting the practical challenges, we integrated researchers, data management experts, data stewards, data curators, funders, and reviewers, involved in educational research. Continuous exchange with these stakeholders took their different needs and requirements into account. Following this approach, we gathered feedback from different stakeholder groups during the development and improved the usability and understandability of the Stamp from an early point on. Evaluating different parts of the Stamp we collected feedback from the community on, e.g., the structure of the Stamp and its usage or the use of discipline-specific terminology. Thereby, we aimed to foster a low-threshold access to the various aspects of data management and to ensure inclusion of requirements of, e.g., funding agencies, journal editors and data repositories, regarding transparency in research, data archiving and sharing.

Currently, a beta-version of the Stamp is available in pdf-document-form which can be accessed via the website of the German Network of Educational Research Data (VerbundFDB, 2023) and will be integrated in the Research Data Management Organizer (RDMO), an online

1 Institutes involved in the project DDP-Bildung (in alphabetic order): Center for Teacher Training and Education Research (ZeLB, University Potsdam), DIPF | Leibniz Institute for Research and Information in Education, German Centre for Higher Education Research and Science Studies (DZHW), German Institute for Adult Education, Leibniz Centre for Lifelong Learning (DIE), German Institute for Economic Research (DIW) / German Socio-Economic Panel (SOEP), German Youth Institute (DJI), GESIS - Leibniz Institute for the Social Sciences (project lead), Institute for Educational Quality Improvement (IQB), Leibniz Institute for Astrophysics Potsdam (AIP), Leibniz Institute for Educational Trajectories (LIfBi), Leibniz Institute for Psychology Information (ZPID), Qualiservice, University Bremen.

2 Similar approaches to develop a domain data protocol for a particular discipline started for archaeology in terms of the ARIADNEPlus project in 2019, too.

tool for data management planning. The Stamp contains a *basic module* and eight *content modules*, covering various types of data, methods, and topics dealt with in educational research. The basic module contains information on the Stamp, the research project, and the data processed. It includes, e.g., the title of the project, the researchers involved, the types of data managed, or the mode of data collection. Users of the Stamp should provide appropriate information, update, and adapt it to changes in the research project and its data, e.g., when changing the mode of data collection. Such information provides a first set of metadata, to describe the data, e.g., for registration in online repositories and data catalogues. Information covered in the basic module is set up following the metadata core set of the German Network of Educational Research Data (VerbundFDB, 2019), employed as an example of machine-readable metadata standards that can be mapped to other metadata schemas, e.g., of DataCite (2021) and the DOI-System (DOI Foundation, 2023).

As illustrated in Figure 1, the eight content modules cover different topics of data management, such as research ethics, data protection, transparency, or data sharing. These modules follow a hierarchical structure. On an initial level, each module provides a *minimal condition* to manage data in the context of the respective module. For example, the requirement on transparency states:

> "Data and related materials are processed and documented during the entire course of the project in such a way that project members as well as third parties can 1) retrace the entire data genesis and 2) (re-)use the data and related materials in the current project as well as beyond."

Such a minimal condition is not very helpful, on its own, to support professional data management. However, it serves as a kind of 'promise' on how the data will be managed in the project to ensure sharable data in accordance with legal requirements and the FAIR Data Principles.

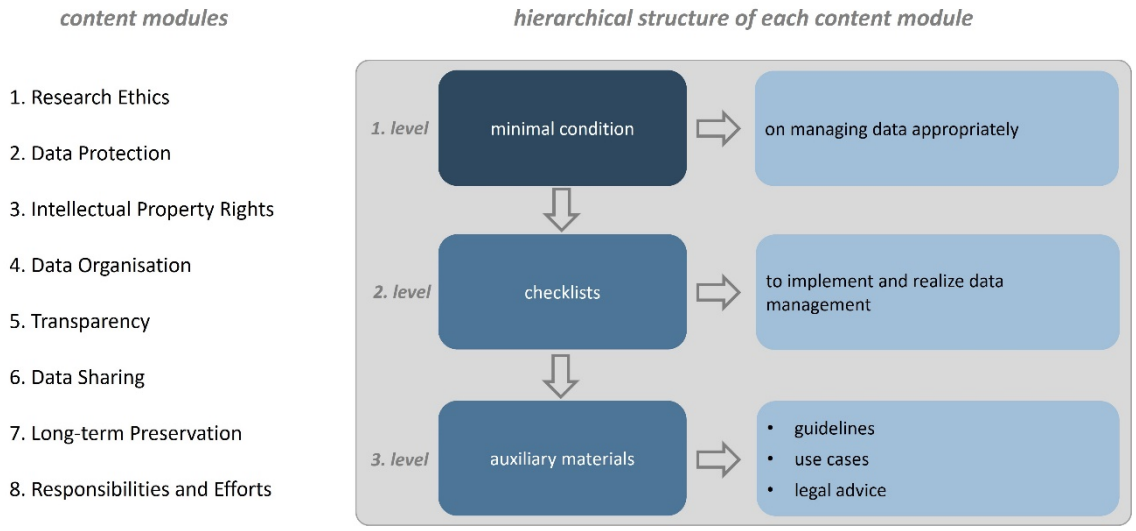

Figure 1: The hierarchical structure of the content modules

How data can be managed appropriately to reach the minimal condition is outlined on the second level of each content module in the form of checklists. These checklists provide guidance on what to do, e.g., describing the sampling process in case of surveys, as exemplified in Figure 2. Thereby, the modules cover various projects and their multitudes of different types of data. Consequently, not all activities listed need to be considered in every research project. Instead, users of the Stamp must specify checklists first, excluding data management activities that are *not applicable* for the current project. For example, while the Stamp describes how to document, e.g., data matrices or transcripts of audio files, a project just running a survey can skip activities on

documenting transcripts. Specified in this way, the checklists provide an overview of activities to be carried out (planning) and document what has been *considered*, already.

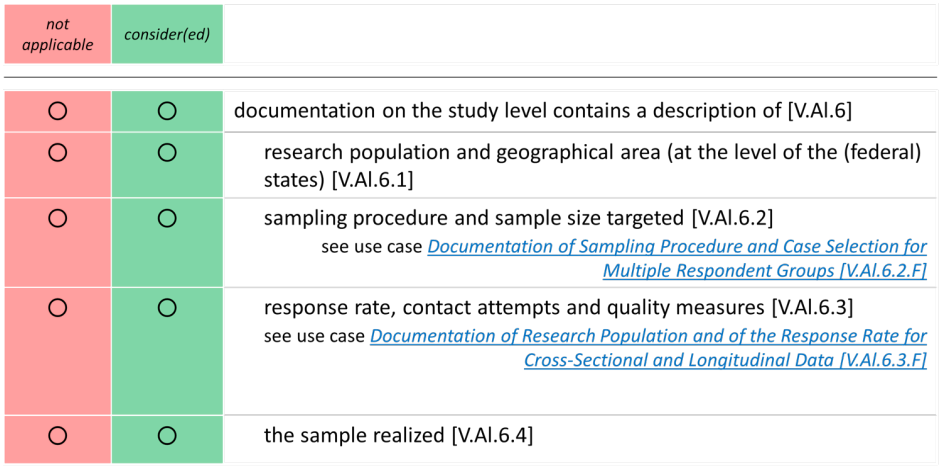

Figure 2: Transparency of quantitative data: Documentation of research population and sampling (extract)

The checklists include references to auxiliary materials, on the third level, supporting the implementation and realisation of data management activities. In general, three different types of such materials can be distinguished: *Guidelines* refer to external guidance, best practise advise and templates of research associations, funders, and repositories in educational research, the social sciences and beyond. In case, such external guidance was not available, but expected to be relevant, short *use cases* exemplify projects in educational research, their challenges in implementing and realizing professional data management, and how the projects overcome the challenges. Finally, checklists in the context of data protection and intellectual property rights refer to *legal advice*, providing a deeper insight in the underlying regulations and their consequences for a professional data management.

How the Stamp Tackles Challenges of Conventional DMP Templates

The Stamp is designed to support the creation of high quality and shareable data. Due to its nature, it tackles most of the challenges of conventional DMP templates outlined above. Addressing researchers' potential lack of information in doing professional data management, the Stamp assists in a multi-layered way. Its checklists can be adapted to the needs and requirements of a particular project and its data processed, providing clear guidance on data management. The Stamp is designed for the use throughout the course of an empirical research project and beyond. It serves as a planning tool that describes and documents data management activities to be considered and thus fosters the planning of data management, its responsibilities, and efforts.

With its flexible structure, the Stamp faces the challenge that 'too structured' DMP templates complicate the implementation and realisation of data management. The Stamp's checklists are a standardised tool for data management, considering different types of data. They illustrate, e.g., the content and structure of data documentation for data matrix, transcripts, video and audio files, and so on. But due to its flexible structure, users can specify the checklists accordingly and exclude activities that are not applicable for their research project and the data managed.

Considering that data management planning and implementation can be time-consuming, the Stamp provides clear guidance and describes one way through data management. It takes

over the planning and highlights activities that need to be considered. Reporting on those activities that have been realized, already, the Stamp becomes a documentation tool. Just like conventional DMPs, it is a *living* document. This is not only true for documenting activities realized, but also in case of reconsidering activities that become applicable in the ongoing research process or regarding the flexibility of updating and adapting information in the basic module. The Stamp thus is a blueprint for data management that additionally can be used in (interim) reports or for the monitoring of the progress of data management.

The Stamp is designed for educational research, providing discipline-specific guidance, standards, and examples. It considers the wide variety of different types of data employed as well as the specific nature of the discipline's research population, such as obtaining informed consent from children or teenagers. Legal advice, embedded in the checklists, provides a deeper insight in the underlying legal regulations, e.g., regarding General Data Protection Regulation of the EU (2016), and explains such regulations considering a highly sensitive research population. Most of the guidelines are discipline-specific referring to guidance, best-practise advise, and templates from institutes and associations in educational research. Use cases describe research projects from educational research and discuss discipline-specific challenges. Thereby, the Stamp employs the terminology of the educational research community, fostering its understandability and usability.

Finally, the Stamp is designed to - at least - set out the opportunity of data sharing. One of the Stamp's modules covers data sharing, introducing pre-conditions, assisting the identification of a suitable repository, and illustrating the process of data archiving in a repository. Information provided in the Stamp's basic module can be used to register, describe, and archive data at the German Network of Educational Research Data, employing machine-readable, standardised metadata and controlled vocabularies, which increase interoperability and improve findability of data in educational research.

To this end, the Stamp not only supports researchers managing their data. It also addresses the difficulty to review data management plans. Being designed to create high quality data according to the FAIR Data Principles, it meets requirements of, e.g., funding agencies or journals on data management and data sharing. The Stamp's minimal conditions therefore serve as a 'promise' to manage data appropriately. According to the structure of the checklists, reviewers can easily understand planned and realized activities and evaluate, if they meet their requirements. Likewise, it is easy to review which activities have already been realized and what still needs to be carried out, e.g., in interim reports.

Conclusions

In our expectation, the Stamp is an innovative approach to improve professionalisation of data management. In contrast to conventional DMP templates, it provides clear and concrete guidance on managing research data. With its checklists, the Stamp exemplifies one way through data management, supporting different stakeholders in data management and data sharing in various ways. For researchers, it reduces time and efforts to plan and realize data management, providing clear guidance, instead of facing users with abstract expectations. Thereby, the Stamp can be adapted and specified for various types of data, enabling a data-type driven data management. Auxiliary materials are discipline-specific, assisting researchers by guidelines, use cases, and legal advice in the context of educational research. For reviewers of funding agencies and journals, the Stamp and its standardised nature simplifies the review process. Finally, the Stamp fosters data archiving in a data repository, considering data sharing and the FAIR Data Principles in its minimal conditions and checklists. Practical applications in data management will show whether these expected advantages will materialise in research projects.

However, the Stamp is one of the first approaches transferring Science Europe's concept of Domain Data Protocols into a practically usable DMP tool. The Stamp focuses on educational research, its research population, and the types of data frequently employed. It consequently lacks different types of data, such as experimental data or data of digital behaviour, and research

constellations, e.g., for inter-disciplinary projects. Considering that research is not static, but dynamically develops over time, the Stamp requires further additions and a (continuous) adaptation to a changing research landscape, as intended by the German Network of Educational Research Data. Regarding the Stamp's focus on educational research, future work needs to figure out the Stamp's usability in other social science disciplines. Aiming to further professionalize data management, it needs to be transferred and adopted to such disciplines, providing better guidance to manage data, and simplifying the review process on data management activities as well as data archiving and sharing. Therefore, the Stamp serves as a blueprint.

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