CWTS REPORT
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CWTS review of Research Portal Denmark: Functionality and user experience

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CWTS B.V.
Centre for Science and Technology Studies,
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Report for NORA

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1. Introduction

The primary report on the Research Portal Denmark provides a comprehensive review of the portal's technical infrastructure, emphasizing its pivotal role in consolidating and openly disseminating Danish research outputs. Developed by NORA, commissioned by and in collaboration with the Danish Agency for Higher Education and Science, the portal serves as a centralized resource that allows researchers, policymakers, and the public to access and analyze Denmark's research landscape. CWTS conducted this review on NORA's behalf, assessing the portal's architecture, data workflows, and technical elements. The CWTS team examined essential components, including data harvesting, linking, and enrichment, as well as organizational coordination and system management, to enhance efficiency, functionality, and data quality in subsequent iterations of the portal.

This additional report undertakes a functional and analytical review centering on user experience, interface design, and the analytical tools of the Research Portal Denmark. We aim to explore the portal's strengths while identifying potential improvement areas.

An intuitive and accessible user interface is essential to serve diverse users, from researchers to policymakers. Critical to this experience is the design and usability of search functions, which must be clear and robust enough to accommodate various queries across multiple data sources. This review will examine whether the search and filtering options are accessible to non-experts in data navigation and flexible enough to allow advanced users to conduct complex searches.

Another critical area is the portal's analytical tools, such as those for Open Access, Green Research, and Research Collaboration, which should facilitate data visualization and meaningful insights. While these tools offer considerable utility, they can be enhanced with features that support tasks like evaluating research impact and analyzing funding patterns. This report will offer recommendations on how to make these tools more comprehensive and user-friendly.

While this report focuses on identified issues to provide constructive suggestions for improvement, it should not detract from the substantial value of the Research Portal Denmark. The current system already offers many relevant resources and flexibility, standing as a commendable and impactful initiative. Thus, the observations here focus less on what is in good shape. They are intended to strengthen the portal further, ensuring it becomes an even more robust resource for its diverse user base.

2. The heuristic evaluation approach

Heuristic evaluation is a method for identifying usability issues in a user interface by comparing it against a set of known usability principles or heuristics. These principles help ensure a system is easy for users to navigate and interact with. This type of evaluation is beneficial for pinpointing potential usability issues without requiring extensive user testing. It's a cost-effective way to identify problem areas and improve the user experience, and combining heuristic evaluations with more in-depth user research can provide a comprehensive understanding of how to prioritize future improvements.

When preparing for a heuristic evaluation, evaluators often use proto-personas—fictional user types created based on team assumptions—to simulate the needs of different stakeholders. In the case of the Research Portal Denmark, proto-personas for researchers, research managers, university administrators, and funding agencies/ policymakers were used. These personas helped guide the evaluation by focusing on the typical tasks and challenges these user groups face, such as navigating the system and accessing or exporting data.

The evaluation process involved observations from various perspectives, using proto-personas to simulate real-world interactions. For this analysis, we used Jakob Nielsen's usability heuristics[1], which is widely recognized for offering broad insights into user behavior and interaction patterns[2]. While there are other domain-specific heuristics, Nielsen's principles provide a reliable framework for assessing the overall usability of interfaces. The Nielsen Norman Group's Heuristic Evaluation Workbook guided the evaluation, though observations were not restricted to pre-defined questions. All findings were grouped under Nielsen's usability heuristics, and recommendations for improvement were provided to ensure a thorough review of the portal's usability. However, Nielsen's model has been slightly adapted for this analysis, reorganizing the original ten heuristics into seven groups. This way, it was possible to avoid redundancy, such as treating error prevention and error recovery/messaging as separate items, which would not be necessary considering the characteristics of the portal.

[1] https://www.nngroup.com/articles/ten-usability-heuristics/

[2] Krawiec, Ł., & Dudycz, H. (2020). A comparison of heuristics applied for studying the usability of websites. *Procedia Computer Science*, *176*, 3571-3580.

3. Heuristic Evaluation

The heuristic evaluation of the Research Portal Denmark aims to assess the usability of the portal's user interface based on widely accepted principles. Each heuristic outlined in this section explores key areas where design, functionality, and user experience can be optimized to create a more accessible, efficient, and intuitive platform for all users. The evaluation addresses crucial elements, including design consistency, error prevention, flexibility, and the quality of help and documentation, while offering constructive recommendations to improve each area.

In line with the portal's purpose as a resource for Danish research, the suggested enhancements balance simplicity with advanced functionalities. These improvements aim to resolve immediate issues and inspire a more cohesive user experience across the portal, aligning with the needs of a diverse audience, including novice users and experienced researchers. Each heuristic offers actionable insights to support the portal's growth as an efficient, user-centered resource, facilitating an engaging exploration of Denmark's research landscape.

3.1 Aesthetic and minimalist design

The design of the portal's user interface should be clean and focused on what's important. Too much information or too many options can overwhelm users, making it harder to find what they need. By prioritizing simplicity and clarity, the portal can ensure that users can easily navigate its features without being overwhelmed by too much information at once.

Overall evaluation

The Research Portal Denmark leverages a minimalist design approach that prioritizes functionality, offering a clean and straightforward user interface. However, opportunities exist to enrich the portal's visual appeal and interactive elements, enhancing user engagement and encouraging exploration. By incorporating more cohesive and visually engaging elements, the portal can further its mission as a resource for Danish research, inviting users to explore, interpret, and interact with the breadth of data available.

Observations

- **Landing page engagement**: The landing page currently functions primarily as a menu, which may not capture user interest. Adding engaging elements, such as interactive visuals or brief data summaries, could offer immediate value and encourage further exploration. Interactive maps or top research insights could give users an accessible entry point into Denmark's research landscape.
- **High-level data visualization**: Users would benefit from a quick sense of research activity across Denmark. High-level visualizations, such as interactive maps or dashboards, would help users gain an overview of research productivity, distribution, and other relevant insights without conducting detailed searches. If used on the landing page, these resources would advertise the value of the information available.
- **Filter and panel design consistency**: Filter options and menu elements vary between local data, patents, and global data sections, creating an inconsistent experience. Standardizing filter panel designs across sections would streamline navigation and make the portal easier for new and experienced users.
- **Unified design across all sections**: Sections such as open access indicators and green research differ in design from the rest of the portal, which may give the impression of separate resources rather than a cohesive platform. Establishing a unified design language throughout the portal, covering all filter panels, analytics, and specialized tools, would enhance the sense of a unified resource. Standardized headers and footers, multilevel menus, and consistent typography choices will help consolidate the resources.
- **Static presentation of analytics**: The portal presents most of its analytics in a static chart format, similar to printed reports. This approach limits user interaction with the data. For instance, national and university results are displayed in separate charts without the flexibility for interactive comparisons. Transitioning to dynamic, interactive dashboards where users can adjust views by parameters like institution or discipline would foster richer engagement, making data exploration and interpretation easier.

3.2 Recognition rather than recall

Systems should minimize the information users must remember by making options and actions visible. This reduces cognitive load and allows users to focus on the task.

In the portal's user interface, search fields, filters, and categories should be easily visible and recognizable, allowing users to make selections without recalling specific details or terms.

Overall evaluation

The Research Portal Denmark offers an intuitive user interface that aligns with recognition over recall principles. However, some adjustments could further reduce reliance on user memory and make distinctions between sections and functions more immediately recognizable. By enhancing visibility and organization, the portal can better support a broader range of users, ensuring ease of use and reducing cognitive demands.

Observations

- **Section differentiation**: Sections for publications, patents, and other data areas are visually similar, with color as the main distinguishing factor. While the approach increases cohesion and provides a consistent user experience, the differentiation based mostly on colors requires users to remember specific color associations for each section, which may increase cognitive load. The addition of consistent yet distinctive visual markers, like header icons and images, could improve immediate recognition without compromising design harmony.
- **Clarity in labeling**: While sections and filter options are consistently organized, they often lack clear, descriptive labels that provide immediate context, particularly beneficial for new users or those unfamiliar with the portal's structure. Adding these labels could help users quickly identify sections and orient themselves within the portal, improving usability without requiring them to recall section details.
- **Consistency in filter menu order**: The order of items within the filter menus varies across sections, which may disrupt efficient navigation. Users might have to remember filter positions, which could slow down their experience. Arrange filter items in a standardized order across all sections, allowing users to locate options based on a familiar pattern rather than relying on memory. For example, place the most used filters (such as data source, publication date, and research area) in the same position in each menu.
- **Proximity of related filter items:** Related filters are sometimes apart; for instance, in the Global Data, the options to filter by "Matching Records in" and "Data Providers" are intrinsically connected but located on opposite sides of

the filter list. Standardizing the filter item order across sections, with commonly used filters like data source, publication date, and research area positioned consistently, would streamline navigation and reduce cognitive effort. While technical limitations may prevent options from being the same, the closer they get, the better the user experience.

- **Unified search modules for local and global data**: Currently, local and global publications are presented in separate panels, creating a division that may feel redundant from a user perspective. Combining these sections into a single, unified panel with filter options that allow users to select local, global, or overlapping data would streamline the interface and simplify navigation. While technical factors may influence the current separation, a unified approach could provide a more seamless experience by reducing the need for users to toggle between sections.

3.3 Consistency and standards from the real world

The portal should align with users' real-world knowledge and expectations, using familiar language and avoiding technical jargon. This approach makes the system more intuitive, creating a seamless experience where users can easily relate to terms and categories. The portal can offer a consistent experience by following common platform conventions, making navigating easier. This is further supported by Jakob's Law, which suggests that designing based on familiar patterns reduces the need for users to learn new conventions. For example, presenting research categories using terms that researchers are already familiar with will minimize confusion. Matching the system's structure to how users naturally think about and interact with research data will create a more seamless and efficient experience.

Overall evaluation

The Research Portal Denmark effectively incorporates many standards familiar to research platform users, such as clear filter organization and labeling, which enhance usability. While the portal is intuitive overall, certain sections could be refined to align with users' expectations and clarify distinctions within data classifications. Enhanced consistency in terminology, icons, and layout across the portal would ensure users feel confident navigating various sections and understanding the information presented.

Observations

- **Contributor information clarity**: It is quite interesting that the portal allows users to filter publications by contributors, particularly when they are

presented in descending order of the number of contributions. However, the filter could benefit from added clarity regarding the affiliations of contributors. Whether contributors are affiliated with Danish institutions or international coauthors are also listed is not always clear. Adding descriptive labels or some other type of contextual information here would help users immediately understand these distinctions, especially within the context of local data.

- **Consistency in SDG classification**: The classification of publications under Sustainable Development Goals (SDGs) varies between local and global datasets, which may need further clarification. For instance, out of the extensive local dataset of over 730,000 publications, only 21,000 are tagged for SDGs, while over 350,000 are tagged out of 530,000 global publications. This discrepancy may confuse users, especially without clarifying the SDG classification methodology. A brief, accessible explanation of the SDG classification methodology through information icons or documentation links would help users better understand this variation.
- **Clarity for Danish main research areas**: Denmark's unique categorization of main research areas may not be immediately familiar to international users. Including concise, user-friendly explanations, such as hover-over text or tooltips, would offer helpful context and make these research areas more accessible to a diverse audience.
- **Use of information icons for complex items or sections**: A pattern derived from the previous topics is that sections may contain complex or ambiguous terms, such as contributor affiliations and Danish research areas, or they could benefit from methodological context. Implementing information icons across sections with potentially complex terminology or classifications, with links to brief explanations or documentation, would help users gain insights without needing to refer to external resources.

3.4 Flexibility and efficiency of use

The portal should preferably be designed to accommodate users with varying levels of experience, from novice users to expert users. Novices benefit from clear guidance, while experts can speed up their interactions with shortcuts and customizable options. By providing multiple ways to accomplish tasks and unobtrusive accelerators like autocomplete while typing, the system enhances efficiency for experienced users without overwhelming beginners. This balance ensures that users of all experience and skill levels can interact with the system effectively.

Overall evaluation

The Research Portal Denmark offers various search functionalities, but several elements could be improved to enhance user flexibility and efficiency. Although the portal provides clear guidance for simple searches, advanced functionalities such as expert queries and query-saving methods lack intuitive design. Addressing these issues will help users navigate, customize, and save searches more effectively, aligning with best practices in research platforms.

Observations

- **Contextual help accessibility**: While the Research Portal Denmark is very intuitive, in some instances, help is required but not always easily accessible. For instance, at the top-right part of the screen, a question mark brings contextual information regarding the selected search type: simple, basic, or expert. The problem is that the icon is currently positioned at the opposite side of the screen to the search type selection, which may cause users to overlook it or fail to associate it with search guidance. Moving the help icons closer to each search field or linking them directly to each search would improve the relevance of the resource, making the help features more accessible and immediately useful.
- **Enhanced search guidance with dropdowns and autocomplete**: In the basic search function, users need to manually enter terms for categorical fields, as dropdown or autocomplete options are unavailable. The examples included, which change according to the selected field, are helpful. However, expanding the information by incorporating dropdown lists, using autocomplete options, or adding contextual help that lists the available options or categories for any search field would be beneficial. In some cases, users can find the options in the filters list on the left, which would make the search fields unnecessary.
- **Support for expert queries with guidance and validation**: The expert query function requires users to have prior knowledge of specific field codes and category options without sufficient in-system guidance. For example, SDG-related queries require users to input specific SDG numbers rather than keywords, which may need to be explained. Adding helpful examples and access to valid category lists within the expert query interface, such as icons or links to resources like SDG codes, would empower users to construct accurate queries more confidently. Ideally, the expert query should work similarly as we see in the Scopus search: users can explore the basic search

options, and when the expert option is selected, all choices already made transport to the query to be further adjusted by the user.

- **Efficient query-saving options**: The current method for saving queries generates a short URL that users must bookmark or save externally. This is an important step for search efficiency and helps users resume or rerun a future search and share queries with other users. However, that approach could make tracking or organizing multiple queries easier. An ideal alternative would be to allow users to log in to the portal, being then able to save their queries to their accounts. Also, it would benefit users to export the full queries as text files, which could help the reproducibility of analyses conducted with data collected from the portal.

3.5 User control, freedom, and awareness

No one likes feeling trapped in a system, especially when they make a mistake. Users should be able to backtrack, undo actions, or cancel tasks if something goes wrong. This flexibility encourages exploration because users know they can easily correct errors. In the context of the research portal, features such as an "Undo" button or a straightforward way to reset a search filter are essential.

Keeping users informed about what is happening in the system is also essential. Timely feedback, such as loading bars, progress indicators, or notifications, lets users know the system functions as expected after an action is taken. When users are aware of the system's operations, they feel more confident and in control. In the context of the research portal, ensuring users know the status of tasks like searches or data retrieval is critical for reducing uncertainty and enhancing the overall user experience.

Overall evaluation

The Research Portal Denmark allows users to navigate the site and explore and modify searches and filters without feeling restricted or "trapped" within the system. This flexibility supports user freedom and control, making it easy to undo selections and adjust filters as needed. However, improvements in filter visibility and search reset options could enhance the experience, particularly for new users or those unfamiliar with the portal's layout.

Observations

- **Complexity of the querying approach:** The portal provides users with various ways to conduct searches, including a combination of search fields and filters.

However, the overlap needs to be clarified for some users, as most search fields can be explored from both the search and the filters, with the second being applied on top of the first. Ideally, search and filters should be interconnected, with selections made in one reflected in the other. For instance, the choice could be displayed in the search area if years are selected in the left filter panel and vice versa.

- **Visibility of selected filters**: The portal's information-dense layout makes it challenging to identify active filters quickly. Selected filters are not prominently displayed on the screen, and their visual design is similar to that of combined search results. Positioning selected filters in a dedicated, highlighted area—such as the top or side of the search interface—would improve their visibility and help users instantly recognize active filters. It is also advisable to change the label "Combined results," which conveys the idea of addition, to "Filtered search results," which better reflects the flow adopted by the portal.
- **Clear query**: The "Clear Query" button is an important addition to the portal, but it introduces another layer of complexity by introducing a third label to the search/filter duo. It can be inferred that the system calls the combination of search and filtering a query, but that may not be understandable to all potential users. It might be beneficial to simplify the approach to avoid impacting user awareness of the available resources.
- **Consideration of user experience levels**: The portal's flexible design could be further enhanced by tailoring visual cues to different experience levels. Visual aids like tooltips, hover-over explanations, or a brief tutorial would be helpful for novice users while keeping advanced features readily accessible for experienced users. This dual approach supports a more intuitive experience across various user groups, making the portal more accessible for all users.

3.6 Error prevention, recognition, and recovery

Error prevention focuses on designing systems that reduce the chances of user errors by implementing helpful constraints, suitable defaults, and forgiving formatting. Instead of relying solely on error messages, the system should proactively guide users to avoid mistakes in the first place. This approach improves usability, reduces frustration, and boosts user confidence. Designers should aim to eliminate error-prone conditions or, when necessary, present confirmation options before users commit to actions. The system can better support users and prevent errors by addressing unconscious slips and conscious mistakes.

Clear, helpful error messages are crucial for guiding users when something goes wrong. Error messages should be written in plain language, and constructive suggestions should be offered to resolve the issue. For example, if a user inputs an invalid search term, the portal should explain why the term isn't working and suggest a valid alternative. This not only helps users recover from mistakes but also prevents frustration.

Overall evaluation

The Research Portal Denmark effectively prevents errors across many of its features, with most sections functioning smoothly and as expected. However, certain usability and input validation issues, particularly related to the search functionality, allow for user mistakes that can yield misleading results rather than prompting corrective actions. A stricter approach to input validation and enhanced contextual guidance could improve error prevention and overall user experience.

Observations

- **Filter application reminders**: When using filters, users must click "apply" for each filter group to take effect. Some users may overlook this step, leading to unintended search results. A reminder message or a pop-up when users first select a filter could reinforce this process, ensuring they know to click "apply" to confirm each filter selection and reduce accidental errors.
- **Error handling improvements in expert queries**: Currently, the expert query function does not effectively handle errors, as incorrect input formats yield results rather than error messages or warnings. For instance, lowercase codes, non-standard syntax (e.g., "language" instead of "LA"), or omitted parentheses (e.g., “LA=danish” instead of “LA=(danish)”) yield misleading results rather than error messages, making it difficult for users to identify and correct mistakes. Implementing stricter validation for syntax and input would help prevent such errors, triggering clear messages that guide users toward correct formatting and improving overall query accuracy.
- **Enhanced support for syntax and operators**: Current contextual help could be expanded to provide clear syntax guidance, supporting users experimenting with various search terms or operators. Contextual examples and suggestions—such as dropdowns with recommended syntax or hints like “Example: LA=(danish)”—would assist users in entering search strings correctly from the outset, further reducing the need for error recovery.

- **Error messaging for unrecognized operators**: The portal does not alert users when unsupported operators or syntax is used. As an example, these are results from performed searches using the PY (year) search code in the Global Data section:
    - PY=2023 results in 1,297 publications, of which only 194 are shown by the filter as actually from 2023.
    - PY=(2023 AND 2024) results in 4,234 publications, which is difficult to understand, as publications should not be registered for two or more years). Searching PY=(2023) AND PY= (2024) gives the same result.
- **Enhance contextual help for search syntax and operators**: Strengthening the contextual help system would provide better guidance on valid search syntax and available operators. A good idea would be to create a page in the documentation with common search queries to serve as a starting point for users.

3.7 Help and documentation

While the portal should be intuitive enough that users don't need documentation, it's still important to provide help when needed. The help system should be easy to access and offer task-focused advice that helps users solve their problems quickly. Support comes in two forms: proactive, such as tutorials and tooltips to prevent issues, and reactive, such as FAQs and troubleshooting guides to resolve specific problems. Documentation should be easy to search, concise, and task-focused, providing clear, actionable steps. Well-designed help systems enhance user autonomy and improve the overall experience.

Overall evaluation

The help and documentation provided for the Research Portal Denmark are vast and detailed in many aspects, but there is room for improvement in terms of user experience. The documentation is spread across different platforms and formats, which detracts from its usability and impacts cohesiveness and intuitive structure, making it difficult for users to access relevant information efficiently. A more centralized, well-structured, and accessible approach is necessary to enhance the user experience. The contextual help offered to the users is limited and could be expanded.

Observations

- **Unified and accessible documentation**: Currently, the portal's help resources are spread across multiple platforms, including separate Google Docs and

website sections, which can disrupt the user experience. Consolidating all help and documentation materials onto a cohesive, accessible platform, such as a knowledge base, would simplify access and allow the documentation to be customized to fit the portal's design more seamlessly. This centralized approach would enhance the clarity and usability of help materials.

- **Placement of essential information**: Core information, such as the portal's mission, vision, and advisory board, is currently located within the help section. Moving these foundational details to a more prominent section of the main website would allow users to easily locate essential information about the portal, creating a more transparent, engaging presentation.
- **Improved organization with a structured manual**: The current FAQ-style layout overlaps with actual help content, leading to redundancy and sometimes finding specific guidance difficult. Reformatting help files into a structured manual, organized by topic with defined sections and subsections, would provide a more logical flow, making it easier for users to navigate directly to relevant information.
- **Clear and streamlined instructions**: Some essential instructions, like how to download search results, require users to consult multiple sections, creating guesswork and making the task less efficient. Presenting these instructions as straightforward, step-by-step guides in one location would ensure users follow each process smoothly without cross-referencing other sections.
- **Enhanced contextual help**: Currently, contextual help via information icons is limited, providing minimal explanations and lacking examples or direct links to in-depth documentation. Expanding these icons with more detailed information, clear usage examples, and links to the complete documentation would allow users to understand the portal's features in real-time better.
- **Improved visibility and functionality of the top-right help icon**: The help icon in the top-right corner only provides information on the selected search mode, which may not meet users' broader help needs. Redesigning this feature to offer general help resources beyond specific search modes would align more closely with user expectations and make locating assistance easier.

4. Conclusions and recommendations

The Research Portal Denmark is a valuable and centralized resource that provides essential access to Danish research data for a diverse audience that includes researchers, policymakers, and the general public. Its functional evaluation presented in this report was structured using a heuristic approach, offering a focused and systematic way to identify usability improvements. Heuristic evaluations are particularly valuable as they allow us to simulate the perspectives and needs of varied user types, from researchers to policymakers, providing a comprehensive means of assessing user experience based on well-established principles.

Our analysis reveals that the Research Portal is a valuable resource, providing users with a rich source of research information that can be explored with significant flexibility. Overall, the portal's user interface design is minimalist and functional, effectively supporting essential research functions. However, we identified several key areas where enhancements could strengthen the user experience, support seamless navigation, and optimize the portal's overall usability.

The findings and recommendations presented across the heuristics reflect the potential to refine this resource into an even more accessible and engaging platform equipped to meet its users' varied needs. While each heuristic presents distinct recommendations, several cross-cutting themes emerged:

1. **Establish a unified design framework**: Developing a consistent design language, covering everything from filter panels and analytical tools to help and documentation icons, will improve the portal's overall cohesiveness and intuitive nature.
2. **Implement accessibility standards:** Adopting the Web Content Accessibility Guidelines (WCAG 2.1)[3], developed by the World Wide Web Consortium (W3C), would enhance the portal's usability for individuals with visual, auditory, motor, and cognitive impairments. Compliance with WCAG's levels, from A to AAA, would expand access for all users, with the highest level of compliance offering the greatest inclusivity.
3. **Integrate responsive design:** Ensuring a responsive design that adapts to various devices, such as desktops, tablets, and mobile phones, will make the

[3] https://www.w3.org/TR/WCAG21/

portal accessible on all screen sizes. A responsive layout enables smoother navigation and readability across devices, broadening accessibility beyond desktop use, where the current design is largely fixed.

4. **Strengthen the help and documentation system**: Consolidate all help resources into a single, easy-to-access knowledge base. Enhanced documentation with clear task-based instructions and easily navigable sections will support user autonomy and simplify onboarding for new users.
5. **Integrate contextual help and enhanced feedback mechanisms**: Place contextual help icons near relevant functions, such as search fields and expert queries, and provide clear error messages that guide users toward corrections. This approach will minimize errors and reduce user frustration.
6. **Enhance analytical interactivity**: Transform static data displays into interactive, user-customizable dashboards that support diverse data exploration needs. Options to compare data dynamically by institution, discipline, or other criteria will allow users to generate insights in real time.
7. **Prioritize accessibility and flexibility**: Implement features that accommodate novices and experienced users, such as query-saving options, tooltips, and dropdown filters. These features will make the portal more accessible and versatile, enabling users to conduct their research efficiently.

In conclusion, the Research Portal Denmark is already a robust and commendable initiative. By implementing these recommendations, the portal can elevate its user experience, creating a more intuitive, engaging, and powerful tool that will continue to support the evolving needs of its users, maximizing its impact as a central resource in the Danish research landscape.