













Disability Advocacy using a Smart Virtual Community

Bushra Kundi¹^a, Dhayananth Dharmalingam²^b, Rediet Tadesse²^c, Alexandra Creighton¹^d,
Rachel Gorman¹^e, Pierre Maret^{2,5}^f, Fabrice Muhlenbach²^g, Alexis Buettgen¹^h,
Enakshi Dua³ⁱ, Thumeka Mgwigwi⁴^j, Serban Dinca-Panaitescu¹^k and Christo El Morr¹^l

¹*School of Health Policy and Management, York University, Keele Street, Toronto, Canada*

²*Université Jean Monnet Saint Etienne, France*

³*School of Gender, Sexuality and Women's Studies, York University, Canada*

⁴*Student Learning and Academic Success Department, York University Libraries, York University, Toronto, ON, Canada*

⁵*The QA Company, Saint Etienne, France*

Keywords: Health Informatics, Machine Learning, Semantic Web, Natural Language Processing, Disability, Critical Disability, Wikibase, Disability Advocacy, Disability Rights.


Abstract: The lack of readily available disability data is a major barrier for disability advocacy globally. The collection and access to disability data is crucial to address social inequities, discrimination, and human rights violations within the disability community. The Disability Wiki project intends to use AI techniques such as Machine Learning and Semantic Web to extract and store existing disability-related data into one platform (Wikibase) and to provide a multilingual natural language enabled search engine and a screen-reader-accessible for its users.


1 INTRODUCTION


The lack of availability of disability data is a major barrier for disability advocacy and disability rights monitoring globally. Disability advocacy information and data is not readily available which can further delay important projects and commissions by human-rights and non-governmental organizations (NGO) (Loeb, 2013).


It is vital to have readily available structured and unstructured disability data from a critical disability


perspective to track systemic discrimination, social exclusion, adverse socioeconomic outcomes, and social inequity for persons with disabilities. Health informatics (El Morr, 2014, 2018) and artificial intelligence techniques (Akerkar et al., 2012; Diefenbach et al., 2017; Diefenbach et al., 2019; El Morr & Ali-Hassan, 2019b; Gorman et al., 2021; Vercouter & Maret, 2012) provide helpful tools to organize, store and search for disability data using Natural Language Processing (NLP). Also, virtual communities that allow remote members to


^a <https://orcid.org/0000-0001-9581-8531>


^b <https://orcid.org/0000-0002-4682-8992>


^c <https://orcid.org/0000-0002-7179-5555>


^d <https://orcid.org/0000-0002-7573-221X>


^e <https://orcid.org/0000-0003-3144-1733>


^f <https://orcid.org/0000-0001-5437-7725>


^g <https://orcid.org/0000-0002-1825-4290>

^h <https://orcid.org/0000-0002-7370-723X>

ⁱ <https://orcid.org/0000-0003-2554-2028>

^j <https://orcid.org/0000-0001-9757-8084>

^k <https://orcid.org/0000-0003-2620-4389>

^l <https://orcid.org/0000-0001-6287-3438>

collaborate over a task have been used successfully in health (El Morr, 2010; El Morr et al., 2017) and search techniques benefited from artificial intelligence to uncover bibliographical data (Muhlenbach & Lallich, 2010; Muhlenbach & Sayn, 2019).

The *Disability Wiki* project aims to create a virtual community consisting of a multilingual web site with screen-reader-accessibility and a semantic data storage (wikibase). The system is endowed with a document upload function with hybrid (automated and manual) paragraph tagging and the querying function implements an intelligent natural language-based search system.

The Disability Wiki project includes 3 phases: ontology development and fine tuning (Phase I), Wikibase and search engine design, development, and testing (Phase II), use and use analysis (Phase III). Phases I and II are presented below

2 METHODS

A computer ontology describing the Convention on the Rights of Persons with Disabilities (CRPD) was developed through constant deliberation and coordination between experts in the field of critical disability studies, health informatics and computer science. The ontology development process was iterative and allowed the critical disability studies experts and health informatics and computer science professionals to fine tune and clarify information description and user requirements. The development of the ontology served as a blueprint for the *Disability Wiki* website.

Background technology used included use of QAnswer, a platform that makes Resource Description Framework (RDF) data accessible via natural language. QAnswer enables intelligent search using intelligent natural language questioning (Diefenbach et al., 2020; Diefenbach et al., 2019; QAnswer, 2021). QAnswer is the first artificial intelligence (AI) driven platform to query RDF data stores in natural language using semantic technologies (QAnswer, 2021). Python and R were both used to prepare and program machine learning models (El Morr & Ali-Hassan, 2019a).

2.1 Glossary & File Tagging

A set of disability rights reports were chosen to train the software for knowledge acquisition, i.e. paragraph splitting and tagging. A glossary of tag terms was then created by experts in the field of health informatics and critical disability to aid in tagging the disability rights

reports. Synonyms were then added to represent a wide variety of tag terms. The glossary was continuously edited and fine-tuned to meet the standards of the disability rights reports and critical disability studies field until expert satisfaction was reached.

To ensure knowledge acquisition, paragraphs were extracted from disability rights reports and a machine learning model was trained to predict the paragraphs' semantic meaning and tag it with the appropriate glossary terms.

Extracted paragraphs were initially automatically tagged using the glossary, then manually re-checked, and re-tagged to train the machine learning model responsible for automatic paragraph tagging.

2.2 Disability Wiki Website

The *Disability Wiki* virtual community website was developed on top of an instance of a Wikibase dedicated to the data storage). It allowed for authenticated users (i.e., information producers) to upload disability documents and use the machine learning to tag their paragraphs. Information producers could delete or add tags if they deem necessary, and the new tag set can serve for new training of the machine learning model responsible of tagging.

Once tagging is done the administrator can push the documents and tags to the wikidata storage.

Using the website search feature, public users can access disability data and information with Natural Language questions. No authentication is needed for public users.

3 RESULTS

The CRPD ontology described relationships between entities in the CRPD. For instance, the CRPD is a convention developed by the United Nations and is composed of several articles, each article has one or several topics. Figure 1 shows a partial view of the ontology.

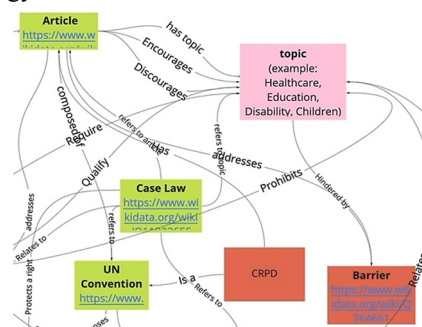


Figure 1: Partial view of the CRPD ontology.

Figure 2 shows part of the glossary that was created for tagging the disability rights reports. Column A shows the primary tags that were used to tag paragraphs while the synonyms representing the terms are in the columns that follow.

A	B	C	D	E	F	G	H	I
client	account							
cognitive								
committee								
common law								
communication	message							
compensation	damages	indemnification	indemnity	recompense	recoupment	redress	remuneration	reparation
conditions	contingencies	provisions	qualifications	reservations	stipulations			
conference	assemblage	assembly	convocation	gathering	ingathering	meeting		
connecting employers and persons with disabilities								
consent	allowance							
consent to medical care								
consequences	aftereffects	aftermaths	backwashes	children	conclusions	developments	effects	issues

Figure 2: Glossary.

Figure 3 shows a page of the *Disability Wiki* project web site. The image shows the search bar with examples of questions.

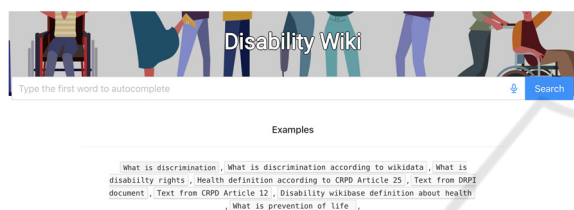


Figure 3: Disability Wiki Web Page.

The disability wiki website uses QAnswer API endpoints to send the questions to and retrieve answers from the disability wiki.



Figure 4: Search function flow of the website.

4 DISCUSSIONS

The multidisciplinary nature of critical disability studies, health informatics and computer science required the researchers to deliberate and coordinate on every stage of the project. To reach a mutual agreement, the project required multiple meeting sessions and re-iteration between researchers for unexpected delays, deadlines, clarification, or challenges.

In the domain of critical disability studies, we are not aware of any other tool or effort for collecting and giving easy access to related data. Our proposal therefore responds to this need.

Giving access to data through the Web is of course not new. However very topic-focused data is too

specific to be adequately made accessible by generalist search engines such as google. Also, the online encyclopedia Wikipedia.org is not suited because it requires editing documents, which is not the case on our platform (document upload).

The web site www.enlaved.org is an example of domain related data collection, however document upload is not proposed, nor automated tagging or semantic free text search.

Future evaluation for the use of the virtual community using technology Technology Acceptance Model or the RE-AIM Framework would be important to understand users acceptance (El Morr et al., 2017). A user interface evaluation is underway to ensure accessibility of the platform.

Finally, the platform supports English and French, and is already expanding in scope as we are currently adding data and documents pertaining to Black Disability Studies and Disability Justice.

5 CONCLUSIONS

Readily available and easy to access disability data is an essential need today. The social model of critical disability allows us to see and address the discrepancies, discrimination, and inequities in the system for persons with disabilities.

The *Disability Wiki* virtual community uses AI techniques to easily integrate and index existing disability data into one accessible platform as well as allowing natural language searching for its' users. The platform is currently in a pilot stage.

ACKNOWLEDGEMENTS

The authors acknowledge and thank The QA Company for providing access to their technology.

FUNDING

The work reported in this paper was funded by the Social Sciences and Humanities Research Council (SSHRC), Insight Development Grant; Grant number 430-2020-00819.

REFERENCES

Akerkar, R., Maret, P., & Vercouter, L. (2012). *Web intelligence and communities* Proceedings of the 4th

- International Workshop on Web Intelligence & Communities, Lyon, France. <https://doi.org/10.1145/2189736.2189738>
- Diefenbach, D., Amjad, S., Both, A., Singh, K., & Maret, P. (2017). Trill: A Reusable Front-End for QA Systems. In E. Blomqvist, K. Hose, H. Paulheim, A. Ławrynowicz, F. Ciravegna, & O. Hartig, *The Semantic Web: ESWC 2017 Satellite Events* Cham.
- Diefenbach, D., Giménez-García, J., Both, A., Singh, K., & Maret, P. (2020, 2020//). QAnswer KG: Designing a Portable Question Answering System over RDF Data. *The Semantic Web*, Cham.
- Diefenbach, D., Migliatti, P. H., Qawasmeh, O., Lully, V., Singh, K., & Maret, P. (2019). *QAnswer: A Question Answering prototype bridging the gap between a considerable part of the LOD cloud and end-users* The World Wide Web Conference, San Francisco, CA, USA. <https://doi.org/10.1145/3308558.3314124>
- El Morr, C. (2010). Health Care Virtual Communities: challenges and opportunities. In M. M. Cruz-Cunha, A. J. Tavares, & R. Simoes (Eds.), *Handbook of Research on Developments in E-Health and Telemedicine* (pp. 278-298). IGI Global. <https://doi.org/10.4018/978-1-61520-670-4.ch013>
- El Morr, C. (Ed.). (2014). *Research Perspectives on the Role of Informatics in Health Policy and Management*. IGI Global. <https://doi.org/10.4018/978-1-4666-4321-5>.
- El Morr, C. (2018). *Introduction to Health Informatics: A Canadian Perspective*. Canadian Scholars' Press. <https://www.canadianscholars.ca/books/introduction-to-health-informatics>
- El Morr, C., & Ali-Hassan, H. (2019a). *Analytics in Healthcare: A Practical Introduction*. Springer International Publishing. <https://doi.org/10.1007/978-3-030-04506-7>
- El Morr, C., & Ali-Hassan, H. (2019b). Descriptive, Predictive, and Prescriptive Analytics. In *Analytics in Healthcare: A Practical Introduction* (pp. 31-55). Springer International Publishing. <https://doi.org/10.1007/978-3-030-04506-7>
- El Morr, C., Maule, C., Ashfaq, I., Ritvo, P., & Ahmad, F. (2017, February 16 -19, 2017). A Student-Centered Mental Health Virtual Community Needs and Features: A Focus Group Study. *Information Technology and Communications in Health (ITCH 2017)*, Victoria, BC, Canada.
- Gorman, R., Maret, P., Creighton, A., Kundi, B., Muhlenbach, F., Buettgen, A., Dua, E., Reaume, G., Mgwigwi, T., Dinca-Panaitescu, S., & El Morr, C. (2021). The Potential of an Artificial Intelligence for Disability Advocacy: The WikiDisability Project. *Stud Health Technol Inform*, 281, 1025-1026. <https://doi.org/10.3233/shti210338>
- Loeb, M. (2013). Disability statistics: an integral but missing (and misunderstood) component of development work. *Nordic journal of human rights*, 31(3), 306-324. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4766593/>
- Muhlenbach, F., & Lallich, S. (2010). *Discovering Research Communities by Clustering Bibliographical Data* Proceedings of the 2010 IEEE/WIC/ACM International Conference on Web Intelligence and Intelligent Agent Technology - Volume 01, <https://doi.org/10.1109/WI-IAT.2010.117>
- Muhlenbach, F., & Sayn, I. (2019). *Artificial Intelligence and Law: What Do People Really Want?: Example of a French Multidisciplinary Working Group* Proceedings of the Seventeenth International Conference on Artificial Intelligence and Law, Montreal, QC, Canada. <https://doi.org/10.1145/3322640.3326722>
- QAnswer. (2021). *Accessing your Knowledge via Natural Language*. QAnswer.eu. Retrieved July 15, 2021 from <https://www.qanswer.eu/>
- Vercouter, L., & Maret, P. (2012). Introducing Web Intelligence for communities. *Web Intelligence and Agent Systems: An International Journal*, 10, 91-92. <https://doi.org/10.3233/WIA-2012-0233>