

Cross Academia and Public Citizen Engagement for Developing Active Citizenship Competences.

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Abstract. This paper explored the effect of the different open cross-university and public knowledge building activities on participants' active citizenship competencies. A survey was conducted with the participants from 7 activities in higher education context in the INOS project. The results report that active citizenship competences could be better developed in cross-academia and public citizen engagement activities that target collaborative knowledge building and data management rather than in more individual crowdsourcing activities. The results indicate that the politico-legal competencies were the most difficult to develop through different activities and they require more specific design concerns in the future citizen science activities.

Keywords: Active citizenship competencies, cross-academia, citizen engagement

1 Introduction

The Era of Citizen Governance streams for the redefinition of the role of citizens, from passive consumers of government services to active participants in governance, where citizens would take greater responsibility for determining their future communities [1]. The key idea of active citizenship is that a person proactively constructs the crucial links between learning and societal action. Active participatory citizenship concept [2] envisions engaging persons proactively in participation in activities that support a community either in politico-legal, socio-economic or socio-cultural domains. Learning for active citizenship is one of the three major pillars in lifelong learning [3].

Open science and citizen science movements (see [4]) have emerged to democratize science-based decision-making processes and for fulfilling the active citizenship needs. Participatory democratic philosophy suggests that transparency, negotiation, and deliberation, as well as responsive policy systems, enhance collective understanding about critical societal issues, integrate diverse constituent groups into governance systems, and enhance the acceptance of collective decisions [5],[6]. Active citizenship may be exercised through open science and citizen science activities that enable both becoming aware of data and scientific results, increasing awareness of problems and its solutions, but also setting new goals, action taking in collaboration with research, and learning about how science is made, co-creating shared knowledge that has scientific as well as public value and stepping in policy actions to make changes.

1.1 Academies' Role in Citizen Engagement for Developing Active Citizenship

The higher education institutions have been seen as active actuating agents in developing the competencies and behaviors. There has been an intention to control the learning results of individuals in objective ways through individual competences rather than addressing the distributed collective capabilities which are difficult to measure. There are competencies attributed to and distributed within social groups and institutions [7]. Our study was conducted in the frames of an KA2 Erasmus+ project Integrating Open and Citizen Science into Active Learning Approaches in Higher Education (INOS) 2019-2022 (<http://inos-project.eu>). The INOS project intended to involve academic and library staff, university students, citizens with various levels of expertise, community members and domain experts from different disciplines and sectors to the co-creation of the open knowledge building activities (OKAs) with the aim of transforming knowledge into innovative artifacts. Co-creating OKAs aimed at upskilling Higher Education Institutions (HEI) (including universities and public research libraries) staff and students through the exposure to contemporary trends in public engagement to critically reflect on pedagogical models conveying active citizenship and social participation. In the INOS project we developed and tested different types of learning practices in which students and educators were engaged as designers and participants of open knowledge building activities (OKAs) that were run to engage different external stakeholders – students from schools, library visitors, interested public and experts, alumni, seniors. These activities are intended to develop among different participants – students, the educators, and the external stakeholders' – the active citizenship competencies.

The research problem of this paper is to find out what effect the different open cross-university and public knowledge building activities can have on participants' active citizenship competencies. We were particularly interested if all the dimensions of active citizenship competence could be targeted with different OKAs, and how the nature of the knowledge building activities might influence different participants' competences in cross-academia and communities' settings. Knowing the learning effects would help academic institutions to design better learning practices for community engagement for improving active citizenship. The research questions are the following: How did the engagement type of the open knowledge-building activity contribute to advancing active citizenship competence dimensions among the participants? How were active citizenship competencies developed among the different participant sectors in the cross-university open knowledge building activities?

1.2 Open Knowledge Building Across Academia and Public Stakeholders

In this paper, we focus on the bottom-up technology mediated open knowledge building activities (OKAs) that academic institutions co-create together with students and external stakeholders for engaging the wider public for social and community purposes. OKAs may cover various forms of open science activities, including more passive and personal interaction based crowdsourcing activities for open data and open knowledge, and the more active collaborative knowledge building and data management activities.

Participating in OKAs may lead to the development of active citizenship competences in open and citizen science context; the development of technical and digital skills or the mastering of new tools among the participants; and the creation of shared open resources in which each stakeholder has an equal interest (widely known as “commons creation”) in a participatory, bottom-up and user-driven way.

Open data is the data that has been collected, digitalized, enriched, validated or interlinked in crowdsourced ways as part of open science activities and made available for public interests. When people are engaged in OKAs their engagement may be only at the level of adding pieces of data to the common pool. This process is usually organized as a crowdsourcing event where people are encouraged to follow data collection protocols. For example, in such activities data may be gathered, sorted, described, linked, or aggregated. In collaborative knowledge building with data the people are encouraged to make out meaning from the data and may use data for co-design or decision-making purposes.

Open knowledge is a kind of shared or crowd knowledge, developed in open knowledge building activities, and is useful for its creators and beyond for the communities and other interested counterparts. Knowledge building refers to the individual and social constructive process of creating new cognitive artifacts, which result in the formation of various forms of knowledge by individuals, groups and organizations [8]. Crowdsourced knowledge building (such as Wikipedia) may be a self-organized creative process that is mediated by digital environments and results in the aggregation of joint knowledge. The knowledge-creation view [9] highlights the importance of the collaborative “triological” knowledge artifact creation that complements “monological” knowledge acquisition and “dialogical” interaction between people for sharing knowledge. Co-creation has been understood in the educational domain as the co-production of shared understandings, making sense, and co-designing and it results in knowledge objects [10].

In the creation of citizen engagement activities, the roles of people from the communities and academic experts must be carefully considered to empower different participants as active citizens. The engagement models in citizen science projects [11], [12], [13] focus on the aspects of agency of people as active citizens for creating data or knowledge in problem-solving activities. They distinguish more passive and active agentic roles of people. For example, engagement in the contractual projects for communities does not enable people themselves of taking action but only involves them in setting goals, the contributory or collegial projects exclude people from setting the project goals and use them mostly in crowdsourcing for data, while in collaborative or co-creative projects the actions around goal setting, data and knowledge building processes, as well as, using the results for transformative changes in the communities can empower people.

In this paper we decided analytically to distinguish between the following activity types as OKAs: 1) less agentic crowdsourcing for data, 2) crowdsourcing for knowledge activities with individual participation; 3) more agentic collaborative knowledge building activities with data- and knowledge co-creation, interpretation and action taking.

1.3 Active Citizenship Competences

Competence is a function of both individual and shared capacity [14]. Boreham [14] has argued that competence should also be regarded as an attribute of groups, teams and communities: making collective sense of events, developing and using a

collective knowledge base and developing a sense of interdependence. After analyzing different frameworks, the most used definition of active citizenship seems to be that active citizenship is “participation in civil society, community and/or political life, characterized by mutual respect and non-violence and in accordance with human rights and democracy” [15]. One of the most used frameworks in Europe is the Active Citizenship Composite Indicator (ACCI) framework which was developed based on the European Social Survey 2002. ACCI covers 19 European countries and it consists of 61 basic indicators divided into four dimensions of active citizenship: 1) Protest and social change (protest, engagement in human rights organizations, trade unions and environmental organizations), 2) Community life (engagement in religious, business, cultural, social, sport, parent-teacher organizations and providing unorganized help), 3) Representative democracy (engagement in political parties, voter turnout and participation of women in political life), and 4) Democratic values (democracy, intercultural understanding and human rights) [16]. In addition, Campagna et al. [17] focused on two types of participation: cultural and civic. The participation in civic life was defined as: “the behaviors and attitudes through which people express their willingness of interacting within the community and contributing to its well-being, as far as four dimensions are concerned: Political life, Civil society, Community life and Civic sense.” [17].

Several scales exist that study participation in civic life. For example, Keeter et al. [18] have developed the Index of Civic and Political Engagement; Doolittle and Faul [19] have proposed the Civic Engagement Scale; Talò and Mannarini [20], and Hoskins and Mascherini [16] have developed the Active Citizenship Composite Indicator. Frameworks concerning active citizenship among youth can also be found. For example, Miranda et al. [21] developed a model suitable for measuring youth citizenship which included two dimensions: community dimension (individual’s relationship with their community associations) and civic dimension (institutional processes such as voting and/or political activism). Šerek & Jugert [22] reanalysed survey data from the International Civic and Citizenship Education Study (ICCS) conducted in 2009 in 38 countries across the world. Among others, they looked into youth trust in country-related institutions (national government, national parliament, local government, courts, police, and political parties), trust in European institutions (European Commission and European Parliament), participation in wider community (e.g., environmental organization or a voluntary group doing something to help the community), participation at the European level activities (e.g., activities in local area that involve meeting people from other European countries or school trips to another European country), political interest (in local, national, foreign and international political issues and national social issues), discussing political issues (discussion with parents and friends about political or social issues and international events), watching news on TV to stay informed about European news, post-materialist value orientation including support for equal rights for immigrants and support for gender equality.

All these frameworks show similarities in the dimensions of active citizenship, but the focus is mostly on political participation. In the current study, we use a three-dimensional model developed by Pata et al. [23] which suggests that active citizenship could be developed considering politico-legal, socio-economic and socio-cultural competencies. Accordingly, this three-dimensional active citizenship approach contains:

- The socio-cultural dimension – focuses on developing social competencies, sets informal education into a particular role in learning for inclusive citizenship. It is about exercising tolerance and democracy in the interaction between individual people’s voluntary activities, self-development, and public sector activities.
- The socio-economic dimension – relates to employment (e.g., developing

employability skills), including access to social benefits – is about making individuals less dependent upon the state, mobilizing them for transforming learning into desirable values for people. It targets competencies needed for developing active citizens' services (e.g., social enterprises, social engagement) and agency.

- The politico-legal dimension – encourages civic and political participation – aims at channeling persons' political agency so that democratic practices would be 'owned' by citizens. It is not just voting (responsible citizenship) but competencies of being engaged in policy-making (active citizenship) so that the specific socio-political order can be democratically reproduced.

2 Methodology

2.1 The Sample

This paper discusses seven open knowledge building activities (OKA) that were conducted in Estonia, Denmark, France, Serbia, Italy, and Finland as part of the INOS project (<http://inos-project.eu>). OKAs of the INOS project required short-term engagement from specific participants (1-2 days) but had to be in long term sustained for iterative usage in HEIs with open participants. In each OKA the process of design and realization was thoroughly documented, particularly we monitored the engagement and open knowledge development aspects. The students and higher educators were particularly intended to be engaged into the OKA development as part of their formal courses or through extracurricular engagements. The learning design guidelines were developed for them. In many OKA cases, the students' engagement into the OKA design remained limited. Several constraints emerged such as from the institutional learning programs, where learning activities and outcomes are usually pre-designed before the students enter into the study, but designing OKAs with the participants' engagement must keep learning activities and learning outcomes more open to be codesigned with the students. The engagement in extracurricular activities into the OKA design was limited due to the mostly online and short format of several activities, as the study was influenced by COVID restrictions.

Here we describe shortly the seven OKAs and the full descriptions may be found at [24]. First, "Noise Pollution at Reid Road" was part of a curricular activity for students where digital environment and the app of Avastusrada.ee and Globises sensors for sound measurement were used. Activities took place both face-to-face and online. "My thesis, Wikipedia and I" was an extracurricular online event for PhD students who contributed to Wikipedia through the topic of their thesis. "SPINE" was an extracurricular online event where the SPINE platform was used for biomedical image analysis. Data Workshop for "Technological and Organizational Trends in Service Design" was a curricular online event focusing on data scraping from online open data sources, data visualization using open-source software and creative use of open data for the discovery phase of the design process. The "Dotmocracy workshop" and "Knowledge building jam" were both extracurricular online activities which focused on integrating citizen science at universities and research libraries. Finally, "Catch up LET" was an online activity for celebrating the long history of the LET programme. It included discussion-based learning activity which provides an opportunity for participants to network and collaborate to cocreate knowledge about diversity in Education. Majority of the participants of these OKAs were somewhat

related to university (see Table 1) as a convenience sample the HEIs had access to, therefore, the participants do not represent a big variety of social groups of the citizens, and this should be considered while interpreting the results of the study.

Four types of activity categories were synthesized across OKAs - crowdsourcing data, crowdsourcing knowledge, collaborative data workshop and collaborative knowledge-building. These differed by the nature of participants' engagement in the activities as explained in Table 1.

Table 1. Open knowledge building activities between higher education and external stakeholders (the full descriptions of OKAs may be found at [24]).

Open knowledge-building activity, country	Type of activity	Learning outcomes and open knowledge created	Participants, number of respondents
Noise Pollution at Reid Road (Estonia)	crowdsourcing data	Knowledge of citizen science / sound volume; using Globisens app, avasturada.ee app; designing the learning activities at geolocate trails for crowdsourcing and evaluating the data and the trails' quality. Open data or knowledge: citizen science trail, crowdsourced dataset from the trail, available openly at avasturada.ee.	In total 39 participants: 25 teacher education students who are working as teachers, 1 mentor, 12 students (15-16 years old), 1 mentor 23 respondents
Edit-a-Thon "My thesis, Wikipedia and I" (France)	crowdsourcing knowledge	Citizen science / Wikipedia approach to enrich scientific inquiry; concrete, hands-on approach to Open Knowledge for PHD students; Wikipedia using and contributing; make use of research methodology outside the academic context. Open data or knowledge: improvement in specific fields of Wikipedia, open access.	In total 12 participants: 7 PhD students, university communities, 5 mentors from the civil society (wikipedists) 7 respondents
SPINE (France)	collective data workshop	Knowledge of brain function and neuroscience / neurodegenerative diseases (multiple sclerosis); inquiry method; using of the data management software; segmenting a brain structure. Open data or knowledge: neuroscience and biomedical image annotation dataset, SPINE platform.	In total 49 participants: 41 extracurricular people, 4 academics, 4 mentors 25 respondents
Data Workshop for "Technological and Organization	collective data workshop	To scrape and visualize data with several tools; understanding of digital methods; to creatively use data in the discovery phase of the design process. Open data or knowledge: Instagram	In total 49 participants: 46 students, 1 professor, 1 postdoctoral researcher,

al Trends in Service Design” (Denmark)		data visualization, public access.	1 PhD student 13 respondents
Dotmocracy workshop (Serbia, Bulgaria)	collective knowledge-building	Open and Citizen Science application in an academic setting; copyright application in Citizen Science projects; collaborative use of documents; presentation skills, project creation/planning skills.	20 extracurricular participants, 7 of them students, 3 mentors 7 respondents
		Open data or knowledge: Citizen Science project concept, presentations.	
Knowledge building jam (Italy)	collective knowledge-building	Open and Citizen Science application in an academic setting; copyright application in Citizen Science projects; collaborative use of documents; presentation skills, project creation/planning skills.	31 extracurricular participants, 3 of them mentors 13 respondents
		Open data or knowledge: Citizen Science project concept, presentations.	
Catch up LET (Finland)	collective knowledge-building	To get familiar with educational design research and activities; to deepen the contacts and relations between alumni and working life cases and current students; to get knowledgeable of the continuous learning possibilities in the field of education.	In total 27: 4 academic staff, 23 students and alumni 6 respondents
		Open data or knowledge: Collective design activity.	

2.2 The Research Instrument

To measure participants’ active participatory citizenship competences, a survey instrument was developed [25]. We combined above mentioned survey instrument frameworks and approaches [16],[18],[19],[20],[21],[23] about active citizenship to develop a survey instrument with 15 statements for the current study. The survey instrument (see Table 2) consists of the three dimensions of active citizenship: socio-economic (1-5), socio-cultural (6-10) and politico-legal (11-15). Within each dimension there are 5 questions that target the knowledge (items 1, 2, 6, 11, 12), future activities (items 3, 7, 8, 13) or values (items 4, 5, 9, 10, 14, 15). The survey has a Likert scale (from “I certainly agree” to “I certainly disagree”). The Cronbach Alpha of all the survey items was 0.87, while for socio-economic items (0.81), socio-cultural aspects (0.78) and politico-legal aspects (0.80), knowledge aspects (0.77), future activities (0.70), and value aspects (0.68). The survey also had some open questions about positive and negative aspects they perceived in OKAs that we used for qualitative insight into survey results about designing open knowledge building activities. However, these open-ended questions were answered only by a small group of participants, and we decided not to analyze these answers in the current paper.

The survey was conducted in the national language of respondents in an online survey format separately in each country after each open knowledge building activity and all the participants were asked to fill in the survey. The survey was attributed to the participants anonymously. Due to the COVID-19 pandemic, many of the tested OKA activities took place online, which created some difficulties in motivating the participants to fill in online surveys after lengthy online activities. Among the 7 activities from where we collected the results, the response rate was 37%, 84 of 226 participants providing the answers. The number of respondents that provided complete responses to all the statements was 61. This study represents mostly the view of academia as 48% of the respondents were students, 23% were educators, and only 19% were external participants and 10% were experts.

Data analysis was conducted with IBM SPSS Statistics. Firstly, we computed the mean compound values for all the active citizenship competence dimensions. Next, we compared with ANOVA the mean values of different OKA types. And thirdly, we compared the mean values of different types of participants in OKAs - students, educators in academia, external experts and external from academia participants.

3 Results

3.1 How Does the Engagement Type of the Open Knowledge-building Activity Contribute in Advancing Different Active Citizenship Competencies among the Participants?

Table 2 provides the overview of the survey items and mean values. In some OKAs the survey was not completely filled in, particularly the aspects of policy making and taking action were not answered by some participants.

Table 2. The mean responses to the active citizenship competencies survey.

Statements evaluated through your experience in the activity (5 - I certainly agree, 4 - I rather agree, 3 - So and so, 2- I rather disagree, 1 - I certainly disagree).	Mean	St. Dev	N
1. I know how open science and open knowledge can be used in social entrepreneurship.	4.17	0.848	84
2. I know how citizens can use open data and knowledge for developing various services for the communities.	4.07	0.889	84
3. I will offer my skills and knowledge for developing for the community various services that use open data and knowledge.	4.34	0.873	83
4. It is important that citizens offer their knowledge and skills for developing for the community various services that use open data and knowledge.	4.54	0.712	79
5. It is important for citizens to participate voluntarily in crowdsourcing to help the community.	4.44	0.782	84
6. I acknowledge that my participation in open science practices changes my knowledge, behavior and values about the importance of science for society.	4.32	0.838	84
7. In the future I will voluntarily help others in my community using open science approaches.	4.14	0.910	66
8. I will use open science and open knowledge to make my community better for everyone.	4.25	0.830	61
9. Tolerance and democracy are important values in society.	4.67	0.641	66

10. All citizens should be equally included in the community.	4.45	0.898	66
11. I know how open science practices can help political decision-making.	3.80	1.153	66
12. I know how to use open data and open knowledge for political decision-making.	3.52	1.026	61
13. I will express my opinions about political and social issues publicly in the future.	3.36	1.172	66
14. It is important for a citizen to be active in political decision-making using open science practices.	4.03	1.064	61
15. All political decisions should be open for the citizens to take part in the discussions or collect evidence.	4.03	1.016	61

We explored the survey dataset by types of open knowledge activities using the computed compound values. The highest mean value was in socio-economic, socio-cultural and values components (respectively 4.3), the knowledge of practices and readiness to use the practices was ranked a bit lower (respectively 4.0), the lowest mean value was in politico-legal component (3.7). It was found that the OKA activity type (crowdsourcing data, crowdsourcing knowledge, collaborative data workshop and collaborative knowledge building) might have influenced the opinions of the participants (see Table 3). ANOVA results (Table 3) indicated that the type of OKA influenced significantly the responses to the socio-economic dimension statements of active citizenship ($p=0.002$), but not to the socio-cultural ($p=0.08$) and politico-legal ($p=0.31$) dimensions.

Table 3. ANOVA comparison of open knowledge building activities based on active citizenship competence dimensions.

Active citizenship dimensions	Activity type	N	Mean	df	F	p
socio-economic	crowdsourcing data	23	4.00	3	5.42	0.002
	crowdsourcing knowledge	7	4.60			
	collaborative data management	29	4.50			
	collaborative knowledge building	25	4.00			
socio-cultural	crowdsourcing data	23	4.00	3	2.27	0.087
	crowdsourcing knowledge	7	4.60			
	collaborative data management	29	4.50			
	collaborative knowledge building	25	4.20			
politico-legal	crowdsourcing data	23	3.60	3	1.2	0.315
	crowdsourcing knowledge	7	4.20			
	collaborative data management	29	3.60			
	collaborative knowledge building	7	3.80			
knowledge	crowdsourcing data	23	3.60	3	3.06	0.033
	crowdsourcing knowledge	7	4.30			
	collaborative data management	29	4.10			
	collaborative knowledge building	25	3.90			
future activities	crowdsourcing data	23	3.60	3	2.94	0.038
	crowdsourcing knowledge	7	4.50			
	collaborative data management	29	4.10			
	collaborative knowledge building	24	4.10			
values	crowdsourcing data	23	4.30	3	1.35	0.262
	crowdsourcing knowledge	7	4.60			
	collaborative data management	29	4.40			
	collaborative knowledge building	25	4.10			

The OKA type also significantly influenced the responses to the knowledge ($p=0.03$) and future activities ($p=0.03$) dimensions, but not to the values ($p=0.26$) dimension of active citizenship statements. Particularly, the crowdsourcing data activity received lowest means in survey responses. This finding corresponds to the opinion (see [11],[12],[13]) that merely individual data collection in citizen science type of activities does not engage and develop participants as active citizens. Collective knowledge building activity also had the statements with lower means compared with crowdsourcing for knowledge and collective data management activities. This result may be partially explained by the short time period of online knowledge building activities, that could not engage participants particularly in bringing their open knowledge to the next level, such as for developing ideas further, or bringing them to the decision makers.

3.2 How Were Active Citizenship Competencies Developed among the Different Participant Sectors in the Cross-university and Public Open Knowledge Building Activities?

In the open knowledge building activities of INOS project the intention was that different target groups in academia (students and educators who design and run the OKAs), and the external experts and other interested participants would all gain new competencies and become more agentic through open science and citizen science approaches. We measured the participant groups' active citizenship competences only once, after the activity. Thus, our results show the level of competence, rather than the competence development with the activities. The significant difference ($p=0.008$) between students, educators, experts, and external participants in active citizen competences was found only in the dimension of values ($p=0.008$) (see Table 4).

Table 4. ANOVA comparison of active citizenship competences among students, educators, external experts, and external participants who attended the OKAs.

Active citizenship dimensions	Activity type	N	Mean	df	F	p
socio-economic	student	40	4.20	3	2.331	0.08
	educator	19	4.10			
	expert	8	4.80			
	external participant	16	4.40			
socio-cultural	student	40	4.20	3	2.430	0.07
	educator	19	4.20			
	expert	8	4.80			
	external participant	16	4.40			
politico-legal	student	33	3.70	3	1.667	0.18
	educator	8	3.30			
	expert	8	4.10			
	external participant	16	3.90			
knowledge	student	40	4.00	3	1.737	0.17
	educator	19	3.80			
	expert	8	4.50			
	external participant	16	3.90			
future activities	student	40	3.90	3	1.231	0.30
	educator	18	4.00			
	expert	8	4.50			

values	external participant	16	4.00	3	4.187	0.008
	student	40	4.20			
	educator	19	4.00			
	expert	8	4.70			
	external participant	16	4.60			

As expected, the external experts' mean value was highest compared with other participants in all the active citizenship competence dimensions. Surprisingly, in the politico-legal and knowledge dimension, the educators' mean values were the lowest among all, which may indicate that such open science and citizen science practices are not comfortable for them in educational settings. Students', educators' and the external participants' knowledge of open science and citizen science practices as well as knowledge of how to use the data and knowledge from these activities in policy making actions did not reach above average.

4 Discussion

Open knowledge building activities (OKA) in academia should be co-developed as problem-based activities with societal value and importance for people and communities to solve interdisciplinary challenges outside of academia. Examples of such challenges in the INOS project were relating to science, social aspects with community needs.

Some difficulties were experienced with short term OKA engagements across academia and public. Our OKA trials in higher education settings indicated that also the lower hanging fruits in selecting the open and citizen science activity types (e.g., crowdsourcing) were chosen where only few of open and citizen science engagement process phases were at present (participating in problem definition, harvesting the data or knowledge, interpreting the data and knowledge, synthesizing the data and knowledge). Such OKAs could be easily conducted as part of short-lasting tasks at the higher education courses or library events. The collaborative science process in which the results will be taken to the real action, decision-making and policy discussions (e.g. [11],[12],[13]) were not attempted as part of the explored OKAs in higher education institutions. Incorporating these would have required more iterative stages of the activity. We suggest that open knowledge building activities as problem-solving tasks should last throughout a longer study period to reach complex challenges with external stakeholders and have more impact on active citizenship competence development.

A notable gap was found in providing high level engagement activities in open and citizen science education that would also incorporate policy activities, discussions. It was very clear that the politico-legal dimension of open and citizen science was the least developed among the participants who conducted open knowledge building activities in the INOS project. We also recommend the universities and research libraries to build such interaction hubs for citizen science where the results would be systematically mediated through the OKA designs to the policy levels, as this seems to be the weak aspect of open citizen science activities.

Educators were not familiar with open and citizen science approaches, where they give partial or full responsibility to the students to plan their learning outcomes and plan their own learning activities as open knowledge building with external stakeholders within their higher education courses. We believe that higher active citizenship competencies achieved in some collaborative data management and

knowledge-building types of explored OKAs could be the result of sharing the responsibility for planning learning outcomes and activities with students. Involvement of students and external partners and experts jointly in cross-academia OKA development could be fertile ground for creating more self-direction intent and agency among the HEI students.

One of the stakes the OKAs create is open knowledge or data and resources in which each stakeholder has an equal interest (widely known as “commons creation”). The value of such “creative commons” for the participants is related to their ownership of it, which is increased in the co-creation process. It was found in the pilots that some of “creative commons” were perceived as personally valuable for their creators (such as in Edu-aThon, knowledge building jams), while the public open value was not so evident to participants, as the survey items about open data and knowledge indicated. The OKA results were often shared in semi-open formats and participants planned to reuse them in their further activities that were not part of the planned open knowledge activity. However, we noted that all the academic institutions in the INOS project failed to share open knowledge results more publicly to external stakeholders. Within the citizen science hubs, the universities and research libraries might potentially develop, the open knowledge management should be one of the concerns, that can help to scale up different OKA results to the next activities and initiatives. Creating such a sharing venue would be required for further engaging activities.

In some INOS OKAs (e.g., Noise Pollution at Reid Road) open data were created, but since the activity was short term, the amount of open data appeared to be insufficient to make the generalizations. Also, in such activities there was a missing stage to bringing the datasets to the policy-making level, such as for city planning. Such an OKA had a somewhat lower influence on the users’ active citizenship competences than the activities where participants also collaborated on the knowledge and data for problem solving (e.g., Data Workshop for “Technological and Organizational Trends in Service Design”).

4.1 Limitations and future research

One limitation of the study was due to the COVID-19 pandemic – most of the OKAs were performed in an online mode without big technical problems, but the number of people we could reach out with the survey remained lower (only 61 participants out of 226 filled out the questionnaire). That has an effect on the validity and generalizability of results. On the other hand, our study demonstrated an online applicability of open and citizen science approaches and encourages the universities and academic libraries to reach out for external experts and people outside of the university as part of their everyday teaching practices. Still, the majority of the participants of analyzed OKAs were somewhat related to university. Therefore, the current participants do not represent a big variety of social groups of the citizens, and this should be considered while interpreting the results of the study. Another limitation of the study that should be considered is that data about participants' active citizenship competences was only collected after participating in the OKA. Therefore, we do not know participants’ initial level of competence and cannot evaluate if the activities had any impact on their competences. In future studies, participants’ competences should be measured before and after activities to measure the actual impact. Our future research is aligned to Estonian National Strategy 2030, and Sustainable Development Goals of Education, and explores how

formal and informal and nonformal learning activities could be connected for developing holistic citizen agency capacity for regions. Citizen science approaches have a high potential to develop both local problem solving and decision making, and transform students and the people in the public from being passive into becoming the change agents in their regions. Through this research we will specifically address the responsibilities of formal educational institutions to drive the development of active citizenship activity design knowledge transfer to the people.

4.2 Conclusions

To conclude, our findings from open knowledge building activities conducted in cross-academia and public within INOS project report that active citizenship competences could be better developed in cross-academia and public citizen engagement activities that target collaborative knowledge building and data management rather than more individual crowdsourcing activities. This is in accordance with the notion [7],[14] that developing competence, especially active citizenship competence requires making collective sense of events, developing and using a collective knowledge base and collective engagement. Involvement of participants into the design of the activity and taking ownership of the activity (e.g. [4],[11],[12],[13]) should in future OKAs also address the politico-legal active citizenship competences that are currently less developed in open science and citizen science activities. The results indicated that the politico-legal, competencies were the most difficult to develop through our different activities and they require more specific design concerns in the future citizen science activities.

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