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Educating for co-Production of Community-Driven Knowledge

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Abstract: In this paper, we present the project, Community Drive, as well as the theoretical and empirical background on which the project is based. Through technical and humanistic collaboration, the project aims to create models that allow children and young people to participate in overcoming future challenges in cities by becoming active and contributing participants in research and development efforts. Further, the project contributes knowledge about community-driven game tools, user-driven big data and the Internet of Things and their connection with intelligent and socially responsible urban development. The project is conducted in cooperation with the city of Copenhagen, local schools and Aalborg University. Community Drive involves students, aged 10–13, attending schools in deprived neighbourhoods near Aalborg University Copenhagen in southern Copenhagen. This area is characterised by a high rate of unemployment, low income and residents with little or no education. As a result, resources have been allocated for reconditioning the subsidised housing in this area. In this paper, we discuss the ways in which Community Drive, initiated in May 2018, is based on the results of pilot projects conducted from 2014 to 2017. Overall, these studies showed that tasking students with changing their living conditions by redesigning their neighbourhoods is a strong motivational factor. During the redesign process, students were able to construct game-based models of various residents' needs and argue for redesigns based on their knowledge about the area and the ability of certain designs to fulfil the needs of various groups of residents living in the area. We also present initial results from collaboration workshops between schools and professional external local partners. These results show that three themes are central for the collaboration process: building local contact, meaningful local ownership and real challenges and applicable solutions.

Keywords: community-driven research, urban development, citizen science

1. Introduction

Schools and educational institutions do not adequately educate students to engage in independent knowledge collaboration and solve complex societal challenges (Bundsgaard and Hansen 2016; Slot et al. 2017). As an alternative strategy to formal learning, community-driven research can break the boundaries between research institutions and surrounding communities through the involvement of new types of actors, forms of knowledge and institutions (OECD 2011). Involvement of citizens and communities beyond universities and traditional research institutions as participants in research systems has been defined as a megatrend that will influence future research policy (Barreneche et al. 2016). There is an increasing focus on how laypeople and communities outside traditional research institutions can be involved in all levels of research activity, including data collection and categorisation. In the field of learning games, and specifically in the development of science game formats, the ability of games to introduce new approaches to authentic science education has been the main topic of focus (Gee 2007). The field of learning games was inspired by new types of games in which players are invited to participate in real-life professional research processes rather than simulations (Cooper 2015; Magnussen 2017). The development of so-called citizen science games, or scientific discovery games, within the past few years has introduced new elements into the issue of game-based participation in the knowledge domain. The main goal of this type of game is to create a platform that enables and motivates players to help solve scientific problems. This paper presents the project, Community Drive, a three-year cross-disciplinary community-driven game and a data-based project in which students collaborated with urban planners to redesign their neighbourhood by applying game tools and sensor technology.

2. Background

Community Drive addresses extensive scientific and societal challenges regarding the integration of research and education in elementary schools, cooperation across institutions and openness and access concerning the way research is conducted. The project is intended to create a new field of interdisciplinary research based on community-driven research defined here as research that is produced, communicated and applied in cooperation with non-academics and is based on citizen involvement and openness from the earliest phases of problem formulation to the final phases of implementation and evaluation. Community-driven research is

inspired by experiments in open science, open data, open methods and open-method citizen science, but goes further and establishes future and shared-engagement knowledge communities with external actors.

Specifically, the project addresses three challenges regarding the movement towards greater openness, community and impact in the research world. Next, we will briefly outline the three challenges the project addresses.

2.1 Opening schools and measuring competencies in Community Drive

The first challenge is the development of future education and student skills in solving complex problems. The need to identify which competencies will be key in the future has been the subject of education policy debate for several years (Griffin et al. 2012; Dumont et al 2010; Greenstein 2012). One proposed type of competence involves the so-called '21st century skills', which are derived from a number of fields and include skills related to learning, innovation, information, media and technology (Partnership for 21st Century Skills 2004). Research has partly focused on defining and redefining competencies and curricula (Dede 2010) and partly on developing methods to evaluate 21st century skills (Voogt and Roblin 2012). In this project, a range of tools were developed based on cases involving 21st century skills. Citizen awareness and innovation and learning skills are highlighted as key conditions of collaboration between students and actors across institutions and disciplines. The project thus involves both theoretically-based learning design as well as competency assessment tools, addressing the need to develop theories, definitions and tools for community-driven research in elementary school education. The strategic background for this research effort can be found in the Danish school reform, 'The Open School', which requires schools to be more open to society and cooperate with actors outside the schools (Christiansen et al. 2015). Early studies, however, showed that Danish elementary schools insufficiently educate children and young people to self-produce knowledge and solve authentic, complex problems (Bundsgaard and Hansen 2016; Slot et al. 2017). A central part of opening schools to community-driven science is the inclusion of game tools for the development process. This will be discussed later in the findings session.

2.2 Opening the research community

The second challenge the project addresses is the development of a more open and engaging research community. In recent years, research policy institutions, such as the EU Commission, the Organisation for Economic Co-operation and Development (OECD), and a number of private research funds have focused on new practices for open research and innovation have encouraged non-academics to participate in the research and development process (Barreneche et al. 2016). These open 'quadruple helix' collaborators involve representatives from research, businesses, government authorities and civil society and are considered in a number of publications to be the key for greater and more responsible use of research knowledge (OECD 2011). Open research is, first and foremost, a research agenda that can have a greater impact on society.

Although at first it was primarily related to scientific publishing (open access), increasingly, more open research has aimed to encourage knowledge sharing and involvement among users (OECD 2011; Geoghegan-Quinn 2014; European Commission 2014; Budtz Pedersen and Martiny 2016). The research policy agenda is based on the finding that scientific knowledge has the greatest possible impact in a society in which citizens, businesses and stakeholders are invited to participate in research as early in the process as possible. This finding is emphasised by the strong increase in diversity and the amount of open data that is available from public authorities. Previously, specialised expertise was required to analyse big data, but now there are more examples of tools that allow citizens and other laymen to independently perform big data analysis (Marr 2016).

A number of challenges must be taken into account when open data is used in community-driven research, such as challenges related to data quality, bias in data and transparency in tools (Allan and Redden 2017; Martiny, Budtz Pedersen and Birkegaard 2016). One example can be found in research using game elements and involving participants who contribute to the development of knowledge and solutions, also known as 'scientific discovery games' (Good and Su 2011; Cooper 2015). These studies show that the involvement of children and young people in teaching has great educational potential and that there is strong motivation for students to participate in authentic research and development processes in collaboration with professional actors (Magnussen et al. 2014). At the same time, reviews show that this type of community-driven research is largely defined by research, not participatory needs, and that laymen are often included in complicated

research processes without development of their competencies (Magnussen 2017). Community Drive investigates how collaboration can be based on both citizens' expertise and professionals' skills.

2.3 Opening urban development to actual citizen involvement and influence through access to city data

The third challenge addressed by the project is the city's big open data and citizen involvement in urban development. Sensor technology and data have been given a central role in the development of cities in recent years. The smart city and smart society are well-known concepts related to information and communication technology (ICT) and the collection of information about the city's status, which, in collaboration with citizens, can be used to optimise resources and offer citizens new and better services (Ojo et al. 2015). In a smart city, it can be difficult to ensure citizen privacy when information is collected (Gidari 2017). Smart citizens are defined as citizens who use open sources or their own ICT to investigate other citizens' experiences regarding one or more parameters. Citizen measurements may be based on climate-related measurements of citizen mobility and use of urban space. Community Drive focuses on the many types of data obtained in a city and the way in which one can enable citizens to collect relevant data about the city, Use of the city use and its inhabitants. In particular, it examines studies of how existing data can be represented and applied by both students and other actors. This contributes to the development of not only smart cities but also smart citizens, which is important because the potential of the smart city is best realised by citizens cooperating with urban developers and planners.

In a recent mapping review of status and trends in research of citizen science, crowdsourcing or community-driven research from 2013–2018, 15 themes were identified through an analysis inspired by grounded-theory: 1) motivation, 2) evaluation, 3) education and learning, 4) man-machine collaboration, 5) participant experience, 6) impact on research, 7) CS technologies, 8) big data, 9) system or project design, 10) social media, 11) participant development of research, 12) behavior, 13) ethics, 14) cross-disciplinary partnerships, and 15) organizational change (Magnussen and Stensgaard 2019). The review was especially focused on identifying themes with a focus on traditional educational activity and new forms of learning in the field, and revealed central discussions on the potentials of technology in citizen science learning and application of new types of technology. Results related to citizen science learning showed that value is added into knowledge generation by the collective process of a group with multiple competencies. This is specifically through two processes: social learning and learning from experience. These results indicate that it is central to focus on defining the skills of various groups of participants when designing citizen science projects and determining what processes users are able to participate in and what additional training or education is needed for participants to contribute to more sophisticated processes. The review also reveals that technologies will play an increasingly greater role in crowd sourcing in both research and business, and there are central discussions on whether the active input and participation of users will be transformed to more passive inputs with involvement of passive sources of data generated by existing and new types of sensor technologies, bots, artificial intelligence and other types of technology (Magnussen and Stensgaard 2019). The review results are central in relation to developing community-driven research in the presented project Community Drive.

In summary, the goal of Community Drive is to develop a model for establishing comprehensive game- and data-driven research and development cooperation, focusing on the education of children and young people in community-driven research. The project thus aims to create a new research platform and approach based on research co-produced with children, young people, professionals and a municipality. It aims to answer the following research question: Through game- and data-driven methods, how can children and young people develop the competencies needed to participate in the development of technical and humanistic scientific solutions for a city's complex problems in cooperation with professional actors? In the following sections, we describe the hypotheses and approaches on which Community Drive is based and present and discuss the results of previous pilot projects. Finally, the first results from collaboration workshops between teachers and professionals in the deprived neighbourhoods where Community Drive is running in are presented.

3. Methods

Previous pilot projects—specifically, the so-called *City at Play* project—were developed in close collaboration with the Copenhagen City Council Social Services Department and Aalborg University Copenhagen. The project aimed to involve young people in deprived areas as experts on their own living environments and to educate them on the influence of structural factors on their welfare and well-being and on how to use game tools to

apply their knowledge and ideas to recreate and strengthen their neighbourhoods (Magnussen and Elming 2017). From the start, the project was intended to define problems and introduce game-based methodological solutions to implement structural changes in neighbourhoods in deprived areas of Copenhagen, addressing both social and educational objectives. The project aimed to provide real-world contributions to the City Council's urban development and planning and, ultimately, help to realise some of the presented ideas.

The methodology used to develop the components of *Cities at Play* followed a design-based research process involving various design cycles, interventions, analyses and redesigns (Brown, 1992). Design-based research was applied as a methodological framework, and various methods were employed to develop and study the game-based community-driven urban planning environment. The project involved two iterations of a design-based research process (Brown 1992) that involved an increasing number of school classes and departments of the Copenhagen City Council. The first iteration is described in another paper (Magnussen and Elming 2017).

3.1 Study design, methods and data analysis in *Cities at Play*

Cities at Play included four teachers, two seventh grade classes and two ninth grade classes (in total, 90 students aged 13–15) from a school in a deprived area of southern Copenhagen. This area was chosen due to its high rate of unemployment and its residents' limited or lack of education. The school is located in an area with older public housing that suffers from problems involving gangs and drugs. A library, nursing home and kindergartens are near the school. The project was conducted in the local library over a two-week period. The classes worked separately on their models for one week and then worked in parallel during the second week to finish their models for presentation to urban planners from the technical department of the city of Copenhagen. A mixed-methods approach was used. Video observations were used to document the weeks of student design sessions, particularly student dialogue in the design process, to understand how various models were developed and the types of local technical knowledge that were used to do so (Brown and Wyatt 2010). Specifically, the video observations focused on elements that strengthened students' competencies.

Pre- and post-surveys were conducted to measure students' motivation to participate in the project, local knowledge about the area and urban planning, how well the project supported learning of 21st century skills such as real-world problem solving and collaboration compared to what students defined as 'everyday school', how much the project differed from 'everyday school' according to students and students' understanding of their ability to structurally change their living conditions. The digital surveys provided opportunities for quantitative answers, which created an overview of the students' knowledge and experiences, as well as for qualitative answers, which clarified the background for the quantitative answers. The teachers administered the surveys to their classes the day before the course started and on the day the course ended. Semi-structured qualitative interviews with teachers and students were conducted to reveal the possible outcomes and challenges of the project (Brinkmann and Kvale 1996). Qualitative data were analysed, applying grounded theory as a method of data categorisation, and themes were defined based on participant-defined concepts related to perceived knowledge generation and learning practices (Strauss and Corbin 1998). The intervention phase of the project is structured around two design-based iterations, and the teaching design is based on the results of the project mapping phase, developed, involved in interventions, analysed, redesigned and tested based on the results of the analysis.

3.2 Study design, methods and data analysis in first workshops in *Community Drive*

Section 5 in the current paper presents the first results from two collaboration workshops done with teachers and professionals in the deprived neighbourhoods where the project was conducted. A total of 30 teachers from two schools participated in the two workshops conducted by researchers at Aalborg University Copenhagen; teachers were invited into the university facilities to develop courses for students in collaboration with researchers and the external professional partners for whom the students were to solve challenges. Each workshop was planned for five hours of hands-on activities including introduction to design thinking as the structure for developed courses and collaborative development with local partners for ideas involving students in solving challenges. The two workshops were conducted at Aalborg University in February and March 2019. Workshop 1 focused on introducing teachers to design thinking (IDEO 2009), and Workshop 2 focused on initiating collaboration processes between teachers and professional local partners and supporting development of first ideas to courses for students.

Based on the researchers' previous experiences with collaborating with teachers, a hands-on approach was chosen in the introduction of design thinking as didactical structure (Magnussen and Elming 2017). For the

workshop structure, this meant that the attending teachers got to try first-hand how the methods work. An example of this was a facilitation of an adapted version of an introductory Design Thinking material 'The Wallet' (https://dschool-old.stanford.edu/groups/designresources/wiki/4dbb2/the_wallet_project.html). A revision was conducted of the original focus (the wallet) and was adapted to a school context by focusing on a school bag instead. The teachers tried every step of a development of a prototype of a school bag culminating in the production of prototype bags. In Workshop 2, the focus was on dialog between teachers and professionals about collaboration. The group of researchers had arranged for external professional partners to participate in the workshop, and dialog tables were set up for teachers to circulate and discuss ideas for involving students in solving local problems as part of their school education as an approach of introducing both design thinking and partnership involvement in curriculum. This method of introducing new methods and curriculum is characterized as an experimental design (Cobb et al. 2003). DiSessa and Cobb (2004) compare this type of approach as building the plane while flying, which corresponds to the collaborative nature of this particular work, where inputs from shifting actors add and form the collective knowledge.

Workshops were documented through video observations and audio recordings and the themes presented in Section 5 this paper were developed through a thematic analysis of qualitative data from observations from workshops with teachers and professionals (Braun and Clarke 2006).

4. Findings in pilot studies in Cities at Play

As described in previous sections, the three-year research and development project *Community Drive* builds on previous pilot studies, such as City at Play. In this section, the central findings and potentials and challenges of the pilot studies will be discussed in relation to the research approach of Community Drive.

4.1 Structure of courses and educational approach – design thinking

The design of Cities at Play: Community Drive included five phases and was based on the results of previous studies on game-based innovation education and community-driven science games (Magnussen et al. 2014).

As described in Table 1, the participating students progressed through the following phases: 1) inspiration, 2) identification of the opportunities and problems in their area, 3) development of ideas and building of models in the game, *Minecraft*, and with other materials and 4) presentation to and feedback from professional architects and urban planners from the Copenhagen City Council departments. In this section we present results from the pilot studies: Cities at Play.

4.2 Competencies: Real-world problem solving and community-driven urban development

Pre- and post-surveys of students' developed knowledge were conducted in the pilot project, City at Play. These surveys investigated how students perceived the tasks and how they differed from other project-based teaching tasks as well as what type of knowledge students think they develop during the course. The surveys indicated that a majority of students (78%) believed that the overall focus of real-world problem solving in City as Play was different from that of everyday schoolwork (Magnussen and Elming 2017). When asked what was different, students provided various responses, which can be categorised into several themes (see Table 2).

Table 2: Themes of responses to the two post-survey questions regarding City at Play: 'Were the problems you worked with in City at Play different from the problems you normally work with at school?' and 'What was different in City at Play compared to everyday teaching?'

Themes	Examples of student responses
Changing things	'Yes, because we normally don't work with changing things'. 'Yes, because we were working with changing something in our city, which is something we don't do in class'.
Something in the real world	'Yes, a lot, because it concerns the real world and it involved problems we could solve for the entire neighbourhood'. 'Yes, because in a way, it did not involve problems related to school subjects but something in the real world'.
Helping people, not just working for your own benefit	'In school we work more for our own benefit. In <i>City at Play</i> , we made something that everybody could benefit from'. 'In school you need to improve your grades, here we needed to help other people ... #Thatwasnew'. 'Yes, because we had to consider whether it would work because here it's all about people'.

Themes	Examples of student responses
More freedom to make decisions/not predetermined	'What we had to make was not predetermined'. 'It's kind of good because we had to decide on what we needed to build and so on. It's not like that in daily teaching, where teachers have the right to decide'. 'We were allowed to determine/decide most things'.
Using one's imagination and inventing	'We had to use our imaginations'. 'We don't usually talk to architects and invent things'.
Being active	'We didn't sit down all the time'. 'You were free to choose what to do'. 'We got to move around and independently decide things'. 'We were active in <i>City at Play</i> '.
Other tools	'We used other tools'. 'We had to play a game to do our assignment'. 'We were building with LEGO blocks and made models with them'. 'No books, a lot of collaboration'.

The central focus of Community Drive is assessment of the competencies students develop in a community-driven research environment with a design-thinking approach. It is supplemented by assessment of the competencies students develop through participation in complex, authentic problem solving. Through collaboration with the project GBL21 (GBL21.aau.dk), the project develops a unique quantitative competency measurement tool to test which 21st century skills students develop during complex, authentic problem solving. The competence test is developed as a series of scenario-based modules that are standardised through Rasch analyses and is based on previously developed tools (Bundsgaard and Hansen 2016).

4.3 Documenting and representing local knowledge

A central aspect of Community Drive and previous pilot projects has been visualisation and representation of students' knowledge and developed ideas so they have an impact on formal decisions made by the city of Copenhagen regarding particular areas. To do so, the study has identified how students perceive their knowledge and how it can contribute to development of the area. In the project's pre- and post-surveys, students were asked if they had knowledge about their area that the urban planners participating in City at Play did not possess. In the pre-survey, 9% answered either 'Yes, I know a lot that they don't know'. or 'Yes, I know a bit more'. This percentage changed to 45% in the post-survey (Figure 3).

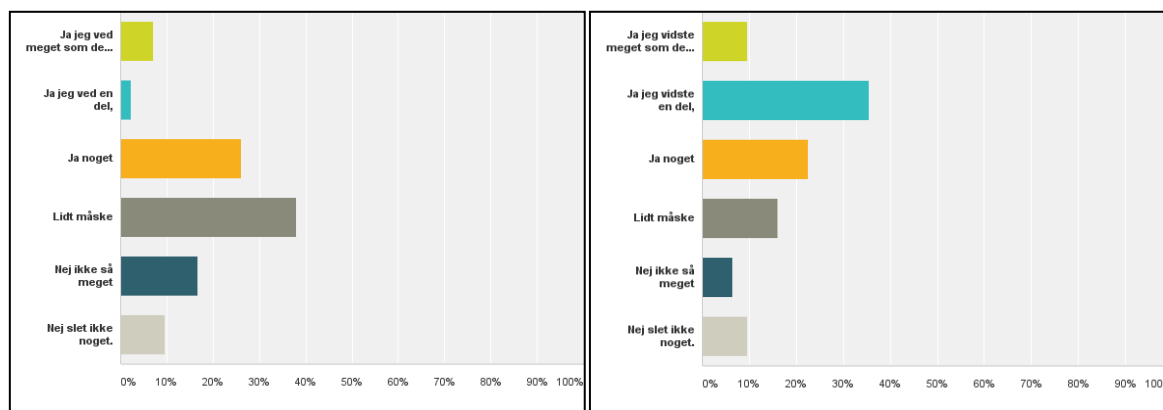


Figure 1: The bar chart on the left shows the pre-survey results, and the one on the right shows the post-survey results

The pre-survey question was, 'Do you have knowledge about Folehaven that the architects redeveloping Folehaven do not have?' In the pre-survey, 7% (green) answered, 'Yes, I know a lot that they don't know'; 2% (light blue) answered, 'Yes, I know a bit more'; 26% (orange) answered, 'Yes, some'; 38% (dark grey) answered, 'Maybe a little'; 17% (dark blue) answered, 'No, not very much'; and 10% (light grey) answered, 'No, not at all'.

Students answered a similar question in the post-survey: 'Think about the City at Play course. Did you possess knowledge about Folehaven that the architects redeveloping Folehaven did not have?' Ten per cent of the students answered, 'Yes, I knew a lot that they didn't know'; 35% answered, 'Yes, I knew quite a bit more';

23% answered, 'Yes, some'; 16% answered 'Maybe a little'; 6% answered, 'No, not a lot'; and 10% answered, 'No, none at all'

These results indicate that the students' perceptions of their knowledge about their neighbourhood and how it compares to that of professional urban planners changed after participating in the pilot project. The study closely examined this change, asking students to qualitatively specify the knowledge that they felt urban planners did not have. The analysis of the data showed that the participating students had specific knowledge about physical buildings or facilities in the area, experiences or feelings in relation to living in the area, experiences or feelings related to specific locations or facilities in the neighbourhood, and social aspects and needs of the community. These areas of citizen knowledge are central in the development of the future project, Community Drive.

5. Collaboration between schools and industry and organisations in Community Drive

This section will first present the results from collaboration between teachers at schools in deprived areas and professional local partners outside schools. As described in the methods section, the workshops were planned as hands-on introductions to the central methodological framework in Community Drive—design thinking and local partnerships. In two workshops the teachers and professional partners developed ideas for courses where students could solve authentic problems through a design thinking process including phases of exploration, interpretation, ideation and experimentation (IDEO 2009). Workshop 1 was focused on introducing teachers to design thinking in education by involving them in a hands-on run through of the design thinking process. At Workshop 2, both teachers and professionals from industry and organisations in the local area participated. Before the workshop, the professional partners, in collaboration with the researchers in the project, defined the problems that they needed the pupils help to solve. The three cases were: developing the local café with youth-friendly activities and healthy food, helping build models for new facilities at the local cultural centre and helping develop ideas and models for a future public sports centre that the city of Copenhagen is planning in collaboration with several organisations. At Workshop 2, teachers and professionals met for the first time and discussed cases and how to involve pupils in solving tasks in relation to the subjects teachers were teaching: science, math, mother-tongue language and creative and design subjects. Overall, the workshops, and especially the hands-on approach, was received very well by both the teachers and the professionals. One teacher expressed this in the evaluation of the workshops: 'I think it was really great to do all this by hand and trying all of this on yourself' (Participant 3, Workshop 1). Another teacher pointed out how this approach supported the transfer of the content of the workshop to the classroom and work with students: 'It also makes it easier to understand the obstacles the students will face when they try the material' (Participant 8, Workshop 1).

In this section we present the initial results from data analysis of video observations and audio recordings of collaborative activities in the two workshops. The outcome of this work is still in progress, and the teachers are designing new materials where they incorporate both partnerships and design thinking elements in the curriculum for 2020. The themes presented in this paper were developed through a thematic analysis of qualitative data from observations during the workshops (Braun and Clarke 2006).

Table 3: Overview of the identified themes and sub themes

Themes	Examples of workshop attendee responses
1. Building local contact <ul style="list-style-type: none"> The teachers do not know how to find and make contact with potential partners. 	<p>'The real problem is, as a matter of fact, that we currently do not have any local partners. So if we were to go out and create a contact with a local partner, and ask them to contribute with concrete challenges, then a local webpage could be created'. (Participant 7, Workshop 1)</p>
2. Meaningful local ownership <ul style="list-style-type: none"> Creating solutions locally to make the partnership explicitly visible Making the process and results visible to other interested parties 	<p>Participant 9: '(...) using partners in the local areas we are in and the partners there, instead all of us wanting to work with the newest and the hottest'. Participant 8: 'Yes, and it is places they [students] use all the time, which helps them to see what they have created'. Participant 7: 'Keeping the ownership'. (Participant 7,</p>

Themes	Examples of workshop attendee responses
	8, 9, workshop 1)
3. Real challenges and applicable solutions <ul style="list-style-type: none"> Challenges have to involve partners with a need for solutions to be perceived as 'real challenges'. Solutions developed by students have to be applicable to partners needs 	Participant 7: 'Because there needs to be some sort of motivational factor related to have partners report the problems or challenges they face. And if the challenge is not real, if real solutions are not applicable, then they are less likely to join in'. (Participant 7, workshop 1)

The main focus in the study and themes presented in this section are to investigate teachers' perspectives in the collaboration process of didactic development of student collaboration with industry and organisations.

5.1 Building local contacts

This theme depicts the current practice of the teacher's involvement with local partners. From the teachers' perspective, barriers in the collaboration is both to create contact with local partners and to find common projects that engage both students and partners. As Participant 7 said:

The real problem is, as a matter of fact, that we currently do not have any local partners. So if we were to go out and create a contact with a local partner, and ask them to contribute with concrete challenges, then a local webpage could be created where partners could continuously add their challenges to the list. Big and small alike, because then we could solve them in different school years. (Transcripts of video observations, Workshop 1).

Teachers also expressed how collaboration requires resources from schools and partners, which makes it central that both parties' experience benefitting from the collaboration. Participant 3 said:

I believe it takes up a lot of resources to involve one entire class. We could involve some students, but one entire class visiting, teaching, we need to make a project that they (external partners) also find relevant to give something back and forth. It relies more on willingness and giving back to the community. Or helping the development, because they (external partners) find it cool and exciting. (Transcripts of video observations, Workshop 1)

Resources involve a multitude of aspects. The teacher above mentions both time and convenience in relation to field visits, etc. These extra resources are needed from both the school and the partners. In relation to visiting partners and the use resources when planning these types of field trips for young students generally requires two teachers. In reality, this means the use of a substitute teacher or somehow coordinating visits within a specific timetable. The teacher quoted above is also concerned about the resources used by potential partners. Having a whole class visit can take up a considerable amount of space and resources. A survey between a random sample of 305 principals from all over Denmark also noted a lack of contact between Danish primary schools and other actors, such as companies. The report where the survey is published concludes that there is a willingness to include more collaboration with companies, but it also notes the obstacles for these types of partnerships are the creation of contact and, moreover, making these types of collaborations contribute to the students competencies (Skolelederforeningen 2017).

In summary, the main insights are that the participating teachers have a lack of contact with partners and that both creating and maintaining these relationships are resource demanding for all parties involved.

5.2 Meaningful local ownership

The theme of local ownership and the importance of connecting school work to the student's imminent environments was a central theme in the discussion from the teachers' perspectives. One example is this dialog on how students working with local challenges and developing local elements are central:

Participant 9: The United Nations put up a lot of challenges, then thousands applied there instead of using partners in the local areas we are in and the partners there, instead all of us wanted to work with the newest and the hottest.

Participant 8: Yes, and it is places they [students] use all the time, which helps them to see what they have created.

Participant 7: Keeping the ownership.

Participant 8: Yes exactly. It's their immediate environment that have improved.

Researcher: It becomes a point that the development is visible?

Participant 9: At least that is what makes it meaningful and makes it relatable to them. I think that they have not helped with something out in Nordhavnen [somewhere far from the school] or what do I know? (Transcripts of video observations, Workshop 1)

The notion of local ownership is from the teacher perspective highly linked to the fact that students work with partners in their surroundings, which gives the students the opportunity to see changes they have contributed to first-hand. The sense of responsibility is bi-directional in regards to the local ownership. The partners contribute to schools in their neighbourhoods and the school contributes by participating in solving problems and tasks. This understanding is in line with community science with regards to how local ownership should be viewed (Wandersman 2003). Summarizing this theme, the main insight is that the kind of partners the teachers are interested in establishing a relationship with are actors that are located in the immediate environment, that is, within walking distance to the school. The reasoning behind this is that students can see first-hand what they have contributed towards and the practical matter of making visits are feasible with partners that are located near the school.

5.3 Real challenges and applicable solutions

Another theme that emerged from the data revolved around future collaboration between schools and partners. The outcome for potential partners from industry and organisations involved in the process was of great importance to the teachers:

Participant 7: Our real problem is whether or not they [the partners] get an actual benefit from participating.

Researcher: Why is it important that they have a real benefit?

Participant 7: Because there needs to be some sort of motivational factor related to having partners report the problems or challenges they face. And if the challenge is not real, if a real solutions is not applicable, then they are less likely to join in. (Transcripts from video observations, Workshop 1)

From this teacher's perspective, the collaboration hinges on solutions of what teachers calls 'real challenges' and 'real solutions'. This correlates with the general adopted stance on how problems are viewed within a problem-based learning environment (Dirckinck-Holmfeld 2002; Kolmos and Graaff 2003; Ryberg 2019).

Another aspect of the authentic collaboration is what the partners involved in this type of partnership gain. Looking at the responses from the teachers, this seems to be a priority:

Participant 7: But there needs to be some kind of [reward]. If it can strengthen a company's image being represented on the list, and because they [local partners] contribute with challenges locals can solve, but this also needs to be public available.

Participant 8: Then the schools can add what they have participated in, and then [the school] get their name on the list. That they have contributed to urban development here (...) to give a local ownership, for both local partners and the students as well (...) they [the partners] can also show that they contribute to these projects and that they actually take part in students learning and urban development. (Transcripts from video observations, Workshop 1)

These teachers make references to the idea of creating some kind of collaborative tool (e.g., a website) where partnerships between schools and other actors are both facilitated and communicated. The idea is that companies and schools would benefit from being present on such a platform. Summarizing the theme, the main insights are that teachers are seeking authentic challenges and related to this, the need for the student involvement to solve these challenges and that partners actually have an authentic need to gain student

insights and points of view. What is also central in this theme is that teachers are aware that students should produce solutions that are applicable for professional partners. This requires close collaboration between schools and partners in planning what types of outcomes challenges require. Focus in this collaboration needs to be on several aspects, such as formats of solutions (e.g., paper and digital versions), and choice of tasks in relation to level of knowledge required for producing applicable solutions for professional partners.

6. Discussion and conclusion

The current paper has shown how collaboration between young students in deprived areas and professional urban planners can lead to both knowledge building and students' enhanced understanding of their own expertise. The pilot studies, however, also showed that models built by students had very little impact on the decision making in the departments involved in developing the area (Magnussen and Elming 2017). To understand this finding, Community Drive further investigated which forms of knowledge and knowledge processes can impact students' knowledge. Part of this is integrating new types of documentation of students' access to the Internet of Things, using sensors and trackers to document challenges and opportunities in their neighbourhoods and access to technical, social and socio-economic big data from the city of Copenhagen. In addition, the project's activities focus on providing children and young people access to the city's big open data and live data, which were measured, documented and represented by young citizens. As a starting point, access to the city's data allows students to access a wide range of information, such as data about traffic, pollution, light and use of different areas, which is essential to the development of their city and neighbourhood. These data-driven approaches will be central in the future studies in the Community Drive project.

In this paper, we also presented the first processes of collaboration between schools and professionals outside schools in planning student processes of solving authentic problems in the city of Copenhagen. The reported results from workshops show that there are several central focus points in collaboration between schools and local partners: building local contacts, meaningful local ownership, and real challenges and applicable solutions. In the analysis, it became clear that teachers find it central that collaboration be didactical to develop as what can be defined as 'local problem-based learning' where teaching centres on solving authentic problems in the school's local environment. This is to establish local ownership through students' development of solutions that becomes visible and present in their local neighbourhood. These aspects of local ownership are closely related to themes of creating local contacts and creating authentic challenges and solutions; teachers were extremely focused on the notion that challenges should be real in the sense that partners need solutions to them. What also become central in the data is that students should produce solutions that are applicable for professional partners. This requires close collaboration between schools and partners in planning what types of outcomes the challenges require. Focus in this collaboration needs to be both on several aspects such as formats of solutions (e.g., paper and digital versions), and choice of tasks in relation to the level of knowledge required for producing applicable solutions for professional partners.

Working within the cross field between the academic world and praxis brings forward a great deal of reflection. The overarching goal of Community Drive is to bring university, school and professional partners closer together with a humble hope that such collaboration will bring mutual benefits. However, looking at the history of community capacity building, the vision of what is helpful is quickly blurred (Chaskin 2001; Graig 2007). In relation to the theme, lack of contact and resources, the dynamic comes into play when teachers who participated in the workshops talked of a missing relationship with the surrounding area. One possible reaction is that this lack of contact is a gap that universities might be able to bridge. Another issue is that the teachers need experiences of how to involve external actors in their curriculum. However, we might bridge these gaps and create new contacts, but we must also continuously reflect on our own position in relation to the participating parties. These aspects are central in developing common community tasks and collaboration practices for solving them in school—industry collaboration in future community-driven research studies.

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