Advocating for Educational Support to Develop Socially Disadvantaged Young People's Digital Skills and Competencies: Can Support Encourage their Human Development as Digital Citizens?

Toshinori Saito

Seisa University, Yokohama/Kanagawa, Japan
t-saito@gred.seisa.ac.jp

Abstract. Digital skills and competencies, and civic participation based on such skills and competencies (i.e. digital citizenship), are recognised as a challenge for the coming digital society. This paper contends that educational support to develop socially disadvantaged young people's digital skills and competencies has a positive impact on digital citizenship. Accordingly, findings based on four years of action research among a support group for socially disadvantaged youths in a provincial city in Japan and a discussion of the support's impact are presented. Our results suggest that such educational support can expand one's freedom to explore digital technology's potential, self-determination as an active learner in a digital environment, and space to participate in a digital society as a digital citizen.

Keywords: Digital skills · Digital competency · Digital citizenship · Computational thinking · Human development · ICT4D

1 Introduction

Common understandings of the significance of citizens' knowledge, skills, competence, and attitudes in relation to digital technology are reflected in frameworks and concepts developed over the past decade. Such frameworks provide a perspective on both simple digital technology use, and complex activities such as "communication and collaboration" or "problem-solving." Typical of these frameworks are the European Commission's Digital Competence Framework for Citizens (DigComp 2.0) [1] and UNESCO's Digital Literacy Global Framework (DLGF) [2], the latter based on a review of DigComp 2.0 and further investigation into global examples of digital skill frameworks. Both refer specifically to offering a comprehensive and synthesised competence model for digital technology use and for activities emerging from its use by defining several competence areas as targets for citizens' digital competence improvement. Digital citizenship is also a concept that focuses on citizens' knowledge, skills, competence, and

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attitude in relation to digital technology, but it stresses achieving and protecting citizens' rights of democratic participation in digital environments. The Digital Citizenship Education Handbook by the Council of Europe [3] introduces a conceptual model for digital citizenship based on the Council's 20 competences for democratic culture (CDCs). A UNESCO report [4] explains that a core competency of digital citizenship should address how to use digital technology in an ethical, safe, and responsible way, without restricting users' full participation in and contribution to the knowledge society.

Nevertheless, there are few empirical studies on whether and how the establishment of digital citizenship through digital skills acquisition might function to ensure citizens' rights and dignity, especially among socially disadvantaged people in developed countries with advanced digital environments. Among such studies, Kafai, Peppler, and Chiu [5] and Fields, Kafai, and Giang [6] suggest that: the acquisition of digital skills and competencies by citizens is the very social participation that digital citizenship is concerned with; gaps in social participation are strongly reflected in the encounter with programming in particular; educational support within schools and beyond can reduce participation gaps in digital skills and competencies. However, these studies do not highlight the changes that such skills and competencies can bring about in citizens' participation in society, particularly by expanding their freedom.

This paper's purpose is to discuss the actual impact of educational support on developing socially disadvantaged young people's digital skills and competencies (ESDC) in view of establishing digital citizenship. Accordingly, we address this subject using the human development approach (HDA), initially presented by Amartya Sen, which provides a holistic view in terms of fulfillment, well-being, and quality of life. One example of the HDA's practical use is the United Nations' Human Development Index, a composite index of achievements in human development [7] [8]. Uniquely, the HDA centers on expanding human capabilities [8]. In the context of HDA, capabilities represent the freedoms available to every individual, such as social, political, and economic participation, which equal full citizenship and the capacity to lead the kind of life she/he values [9] [10] [11]. Deprivation of these capabilities is considered equivalent to poverty [12] [13]. From an HDA perspective, we ought to understand an individual's educational attempts in terms of the development of capabilities, i.e., the expansion of the freedoms that an individual with full citizenship can enjoy to realise a life worth living.

Hence, this paper presents a research study into the human developmental meaning of ESDC for socially disadvantaged youths living in a mid-sized provincial city in a developed country. For this purpose, the author both engaged in a support group activity to aid the social participation of young people experiencing social withdrawal or school absenteeism and conducted a participatory study to help such young people with their learning about computing. The study addressed the research question: How could ESDC encourage disadvantaged young people's human development as digital citizens?

2 Relevant Literature

This research was motivated by an ethical concern to promote social participation equity through the development of digital skills and competencies. Promoting equity in social participation has been a topic of debate in digital divide studies [14]. Early discussions based on techno-optimism insisted on digital technology's potential for social equalisation [15]. However, at the beginning of the 2000s, sociological arguments pointed out the limitations of technological determinism (see [14]). For instance, Norris [16] asserted that computer access, cultural background, ethnicity, and literacy would become critical elements in the digital divide, i.e., inequality produced by a social gap that determined who successfully benefited from digital technology and who did not. "Digital equity" was derived from these digital divide arguments, which stressed an ethical viewpoint that problematised social inequities in involvement with digital environments (see [17] [18]). Gorski described digital equity as a "social justice goal," focusing on the environment that causes the gap between advantaged groups and others, [11] based on comparative research into young children's computer use among schools with different socioeconomic status and cultural backgrounds.

In pursuit of digital equity, this study focuses on the potential of ESDC to empower young people in a supported group. We focus especially on computing skills as the underpinning of digital skills and competency, which we define as the ability to use computing functions actively for self-defined purposes such as problem-solving and play. This definition is strongly related to "3. Digital content creation" and "5. Problem-solving" in DigComp 2.0[1]. We also refer to the thinking skills underlying such computing skills as computational thinking. The definition of the latter for our purposes follows competence 5.5 of the DLGF [2]: "To process a computable problem into sequential and logical steps as a solution for human and computer systems." Previous literature deemed lack of skills in the use of digital technology as a possible factor broadening divides in social and political participation [19] [20]. This suggests the significance of educational approaches to close the divide. However, literature debating the digital divide in a sociological context has focused on gaps in the availability of information among different social classes, and thus, considers Internet access and information acquisition skills the main issues. By contrast, we focus on the contribution of productive digital skills and competencies to civic participation in digital environments, such as the aforementioned computing skills and computational thinking.

This study also highlights the expansion of "freedom of choice" to reflect human development. "Freedom of choice" represents what a person can choose in each real-life context. The exercise of this freedom corresponds to Kleine's choice framework [21] [22], developed to assess ICT4D (ICT for Development) outcomes. Previous literature on ICT4D (see [23], [24]) has shown ICT's benefit to improve the living conditions of disadvantaged people in rural communities. ICT, including legacy in-formation systems, such as analog telecommunications and the digital network of the Internet, has been observed and conceptualised as a critical factor for community development that improves residents' poor life conditions by expanding their freedom of choice for living.

From the perspective of Kleine's framework, ESDC should be recognised as a means of expanding digital technology's impact on local community members' circumstances. During the development of the ICT4D study, the focus both in research and actual development moved from technology-centered “passive diffusion” toward resident-centered “active innovation” [25]. In response to this shift, assessment frameworks for ICT4D, which incorporated Sen's HDA view, emerged to describe the development of residents' living conditions [22] [26]. Kleine's choice framework [21] was among those that attempted to identify ICT’s contribution toward specific development goals by observing individuals' freedom of choice. The choice framework featured the “enormous potential” of digital technology represented by ICT to facilitate individuals' freedom of choice. Then, to address the actual conversion of this potential into a freedom, it highlighted the comprehensive and plural relationships among several factors such as social structure, agency, dimension of choice, and development outcomes [21]. Our study's focus was thus on active innovation concerning freedom of choice among the supported young people and other support group members, stimulated by ESDC. In particular, we attempted to observe the promotion of young people's freedom as demonstrated by their attitudes as digital technology learners and users, which Shonfeld et al. [27] conceptualised as digital agency acquisition. Our study also aimed to provide an otherwise rare example of ICT4D in a developed country.

3 Methodologies

The study chose action research (AR) as a participatory research methodology. This approach enables participants to find effective solutions to problems they confront in their lives [28] and seeks positive social changes based on democratic values [29]. In AR, researchers and other participants need a shared vision for the process and goal of problem-solving, and learning through shared reflection is most critical in this process [30]. The AR process was implemented in a support group for disadvantaged young people in a rural city in Japan, a developed country. With the cooperation of group members, we worked together to establish ESDC as a new option for supporting young people's social participation. This paper focuses particularly on the findings of a reflective exercise conducted from an HDA perspective on the significance of ESDC.

The author engaged in the group's activity, aiding the rehabilitation and social participation of youths who had experienced social withdrawal or school absenteeism, to conduct a participatory study. The group met in a mid-sized provincial city, and varied in size during the study period from five to ten young people with two to five staff members, either full-time or part-time. The author acted as a part-time supporter, assisting youths in learning various things about computing and informatics. The author collected data in the form of field notes, a series of text descriptions with some pictures and movies, noting events and occurrences, dialogues with the participants, findings and interpretations, and reflections on every session during the study period.

The study commenced in May 2015, following a similar pilot study from December 2013 to January 2014, and finished in March 2020. Findings are based on analysis of field notes from May 2015 to February 2018. During this period, the author and the

youths in the group were involved in introductory computing and informatics learning through practices such as making games, teaching older adults programming with Scratch, constructing a programmable robot called MugBot[1], and practising introductory programming with the C and Ruby languages.

Data were coded by thematic analysis [31] [32] to highlight the research question's essential factors. The coded data contains field notes for 66 days taken from May 2015 to February 2018. For this coding, the author scrutinised the field notes to identify themes capturing important facets of the data related to the research question [32] and concepts relevant to explaining the themes. The author then reinterpreted the coding results to determine themes and issues essential to the research question. This process was supplemented by further observations and dialogues in the field. Full ethics approval was obtained from the Research Ethics Committee of Seisa University (No. 1613).

4 Findings

Based on the data analysis, the author identified four thematic topics as those that gave insight into the research question: (1) ESDC stimulated the youths' motivation to learn computing skills and knowledge autonomously; (2) Computer programming led the youths to the joy of thinking computationally; (3) The youths learned more actively when the author behaved as a co-learner rather than a teacher; (4) The youths' computing capacities augmented their expected roles in the group.

4.1 Autonomous participation in learning computing skills and knowledge

Participation in ESDC by youths in the support group should be characterised as a sign of “autonomy”—an autonomous attitude toward learning computing skills and knowledge. For example, one youth, who was late 20s and had experienced school drop-out and social withdrawal (“Y1” for anonymisation), attended the computing workshop, organised by the author at the group's office almost every Thursday afternoon, alone every week. Attendance at the workshop was left optional for every group member. Although it was rare for Y1 to express motivation to participate in the workshop, Y1 did occasionally show a will to continue learning about computing and to practice independently whatever interested them in the workshop. The author found this “autonomy in learning” during the workshop to be valuable in human development because most participating youths had been more or less deprived of this autonomy by their drop-out experiences. Below are excerpts from the field notes (originally written in Japanese) suggesting Y1's autonomous participation in learning computer programming.

[1] MugBot is a nonproprietary, open-source social robot originally designed by the Koike Laboratory in Tokyo Metropolitan University. http://www.mugbot.com.

Table 1. Excerpt from field notes, June 15, 2017

*(This is the answer Y1 gave to a question from a group staff member asking the motivation to learn computing. ** signifies the author's name.) "Maybe if ** cannot visit here, I think I will open the PC by myself and do something with it." (June 15, 2017)*

Table 2. Excerpt from field notes, July 13, 2017

By the way, from Y1, the decision to learn Ruby language after C language was clearly stated. C and Java, according to Y1's examination, are the languages that "learning cost" is high and should be avoided as a learning object, and learning Java after learning C seems complicated for Y1. (July 13, 2017)

Y2, who was also late 20's and had experienced school drop-out and social withdrawal, had been a supported member of the group and participated in the author's workshop to learn computer programming for one year. Y2 then stopped attending the group (for reasons that included getting a part-time job and starting a high school correspondence course). Subsequently, Y2 suddenly visited the group's office and described their decision to learn programming again, in response to the author's invitation.

Table 3. Excerpt from field notes, February 15, 2018

*Today, Y2 will join the workshop again. I received a message about that from S1 (the chairman of the group) this morning. Y2 visited ** last week. At that time, ** invited Y2 to learn computer programming again. Y2 seems to have captured it positively. (February 15, 2018)*

4.2 Computer programming leading to the joy of computational thinking

The experience of computer programming in the workshop seemed to lead youths to feel the joy of thinking computationally. The author featured computer programming as the workshop's main content as it would allow learners to use active and creative thinking. In particular, they go back and forth between their imagination and sequential and logical ideas to solve their problems, which might correspond to computational thinking as defined by competence 5.5 of the DLGF. This happened in the workshop, and the youths seemed to be motivated mainly by the joy of writing and executing the programs they made. Programming especially appeared to give youths room to reasoning about a problem, express their ideas, obtain immediate feedback through executions, and to debug if errors occurred. This process seemed valuable from a human development viewpoint as, through computer programming, youths regained the joy of active thinking they had previously lost. The excerpt below describes this.

Table 4. Excerpt from field notes, May 11, 2017

When Y1 tried to give a hint about the execution result of the program S2 (one of the supporting members and also one of the participants in the workshop) made, S2 said, "Don't say that, don't say that, please!" However, it seemed that S2 had heard the hint after all. S2 said "boring (with a laugh)" after hearing it. S2 seemed to have enjoyed thinking alone (that is, S2 loved to solve problems without help). (May 11, 2017)

Typically, in Y1's case, computer programming encouraged a more profound interest in computing and thinking computationally. When the excerpts below were written, Y1 had experienced programming for more than one and a half years with Scratch, Ruby, JavaScript, and C languages. Y1's programming skill level was not extremely high (though it seemed better than that of the average freshman undergraduate). By creating and debugging small pieces of programs, however, Y1 could enjoy reasoning about the cause-and-effect relationship within an algorithm and applying their understanding of the algorithm to new situations.

Table 5. Excerpt from field notes, December 7, 2017

*Y1 used the program they created just now to calculate the difference from 0:0:0 AM to 23:59:59 PM and told me that "the number of seconds in a day is …." Y1's use of imagination to get interesting results by creating and running programs made me feel Y1's computing affinity. Probably, such imagination came out because Y1 had developed ideas of computing while programming to some extent. ** thinks the thought that produces such computing ideas may well be called computational thinking. (December 7, 2017)*

4.3 Supporting the youths as a co-learner rather than a teacher

Providing support as a co-learner was key to the supporter's attitude when helping youths to learn digital technology. Youths seemed to learn more actively when the author behaved as a co-learner rather than a teacher. When the workshop started, the author acted as a teacher rather than a co-learner because the youths who were interested in or joined the workshop were all complete computing beginners. The author thus had to teach many things about computing and computational thinking, which resulted in the author adopting the attitude of a teacher. This attitude, however, sometimes led workshop participants to adopt a passive learning role. Y1 in particular expressed apparently negative responses, typified by the excerpt below, toward something the author recommended that Y1 should learn next.

Table 6. Excerpt from field notes, March 9, 2017

*** explained the outline of the HCP Chart[2] and said, " I think that this is a big learning point, isn't it?" In contrast, Y1 muttered in a small voice, "I do not want to do it." Then, as an outline, ** explained, "The most important thing is that it enables us to show the purpose and means firmly, in the flowchart you will only write means." Y1 put down a book and said, "I do not understand." (March 9, 2017)*

Conversely, when the author behaved as a co-learner who was tackling the same problem as the youths participating in the workshop, their attitudes to learning computing skills and knowledge seemed to become more active and even autonomous. Learning over time, the author tried to express a manifestly "co-learner attitude," sitting beside the learners in what the author regarded as a "co-learner position." The excerpt

[2] An HCP Chart (Hierarchical ComPact description chart) is a notation system for designing program structures developed by Yokosuka Electrical Communication Laboratory Nippon Telegraph and Telephone Corporation (currently NTT). See [33]

below describes the author's reflections on practicing programming alongside the youths in the workshop.

Table 7. Excerpt from field notes, February 1, 2018

*As soon as Y1 saw the state that ** got an error saying "Hmm...," Y1 immediately looked into **'s PC monitor. As ** expected, sitting in the co-learner position seemed to make it easy to create a cooperative (?) learning space. Then Y1 began to tell their progress of the same problem spontaneously. (February 1, 2018)*

4.4 Computing capacities augmenting the expected roles

As youths' computing capacities grew, their expected roles in the group expanded accordingly. This amplification of roles accounts for human development in terms of expanding the capacity to participate in real society. S1 expected Y1 and Y2 to contribute to organising elementary computing workshops for children as facilitators. In practice, such workshops were not realised. However, the author saw several times that Y1 personally undertook the role of introducing programming to the group's newcomers, as the excerpt below describes.

Table 8. Excerpt from field notes, December 21, 2017

*Currently, in front of **, Y1 introduces Scratch programming for the visitor. […] Y1 is doing it for the visitor just by their own decision. (December 21, 2017)*

Y1 also helped the author several times when the author faced problems in coding during the workshop. Judged by performance, Y1 became more knowledgeable about C language functions after several months' learning. It was therefore natural for the author to sometimes ask for their help during the workshop as a co-learner, which granted Y1 a new role in addition that of learner in the workshop. Below is the excerpt, which reveals the author's recognition of this pattern.

Table 9. Excerpt from the field notes, November 9, 2017

*Today's workshop saw more scenes that ** asked for help that ** would like to be taught by Y1 (and actually taught) than the scene ** taught something to Y1. [...] Y1 was obviously more enthusiastic regarding searching for C language system functions, and as a result, Y1 came to acquire more knowledge of C language than ** which could be utilized for problem-solving. [...] In other words, the relationship between Y1 and ** at this workshop became clearly closer to the relationship that supports each other in learning just as "co-runners with learning." (November 9, 2017)*

During the study period, the group began to consider undertaking a website development project for a local shopping mall association with which the group had a close relationship. The author was asked to advise about utilising the project for Y1's job training and agreed to supervise it. Y1 was invited to join the project as the primary

coder and accepted this role. Below is an excerpt of a discussion log involving S1, Y1, and other group staff.

Table 10. Excerpt from field notes, September 14, 2017

S1 wants to use Y1's skills to create a chance for him to participate in society since Y1 is studying a lot at the workshop. S1 thinks it desirable if such a chance is created not purely inside the group's daily activities but within the relationship between the group and the surrounding societies. […] *What is the structure (of the website development project)?* *· S3 (another staff member) is likely to be in charge of management […]* *·Y1 will be in charge of the production, and S1 also wants to be involved in the production with Y1 if possible. (September 14, 2017)*

5 Discussion

What bearing do the above observations have on the question of ESDC's capacity to encourage the development of digital citizens? In terms of human development, ESDC could encourage the human development of disadvantaged youths as digital citizens by, for example: (a) expanding their freedom to explore the potential of digital technology by themselves; (b) stimulating their self-determination as active learners in a digital environment; (c) expanding their space to participate into a digital society.

Concerning point (a), ESDC could help disadvantaged youths to expand their freedom, described by Sen as the opportunity and process of choice [34], to explore the potential of digital technology by themselves. This argument reflects findings (1) on autonomous participation in learning computing skills and knowledge and (2) on the joy of computational thinking. In the author's eyes, this argument implies that such educational support may act as a potential liberator for participants from imposed uses of digital technology. Participants may then expand their computing capacity, regain their freedom of choice in learning about digital technology, and create new technology uses for their own interest. During the workshop, the author took care not to give firm recommendations to participants concerning pragmatic uses of their computing skills and knowledge, such as acquiring job-related skills or qualifications. For the participants, learning computing in the workshop seemed to involve just a spontaneous enjoyment of the freedom of exploring the potential of computing. They seemed to become creative thinkers as they tackled programming problems or made open source robots. The youths' achieved what should be regarded as an expansion of Sen's capability, representing a person's enjoyment of the opportunity to do or be what she/he values [9].

While point (a) focuses on the learning opportunities of digital technology, point (b) illuminates a broader perspective on learning activity itself. Findings (1) and (3), the latter of which relates to the supporter's attitude as a co-learner, suggests that such educational support could assist disadvantaged youths to gain self-determination as active learners in a digital environment. The learner's shift toward self-determination may have multiple causes, however, the expanded freedom of exploring digital technology, shown in point (a), is undoubtedly a significant trigger. Self-determination as a learner in a digital environment signifies readiness to become a digital citizen possessing sense

and use of choice, especially the choice to participate in a digital society that Kleine argued is an essential part of the dimensions of choice [21]. Moreover, the shift also indicates that such educational support corresponds to problem-posing education, which Paulo Freire [35] conceptualised as a liberating education model for oppressed people to become self-determining learners in a digital society.

Point (c) is derived from finding (4) on the expansion of youths' expected roles in the group. As (4) shows, ESDC could encourage disadvantaged youths to acquire new roles in their community as a result of their enlarged capacity to utilise digital technology. During the research period, the supported youths, who were initially novice computing learners, came to acquire new roles, such as workshop facilitator, co-learner in computing, and coder in a website development project. The acquisition of digital skills and competencies by youths expanded the choices available to them both within the group and in the surrounding community. This sort of role expansion inevitably occurs in a contemporary society that is filled with the need to utilise digital skills and competencies in problem-solving and is crucial in strengthening the individual's ability to live as an independent citizen in a digital society.

Role expansion among the youths in the support group was essentially an achievement of ESDC's development goal to contribute to the supported youths' social participation. Judged by the choice framework [21], this achievement was a result of input from the following individual agency-based capability factors: education resources (e.g., the computing workshop); information (e.g., textbooks, web resources, the author's suggestions, etc.); material resources (e.g., computers and other devices the group offered); and social resources (e.g., the group's membership). The achievement was also affected by structure-based capability inputs such as institutions and organisations (e.g., the support group, the local shopping mall association), formal and informal laws (e.g., the NPO law to support non-profit organisations, daily rules held by the group's members), and access to ICT. In the ICT4D context, skill enhancement in ICT use is considered to expand residents' choices and opportunities to live in society [36].

6 Conclusion and limitations

The findings of this paper reaffirm that ESDC has the potential to solve social problems pertaining to digital equity. Furthermore, this study has revealed a need for inclusive educational support for socially disadvantaged people in local communities. This is the third area, after schools and families, in terms of skills and knowledge of digital technology and the capability to learn digital technology independently. In this context, pedagogical studies of the relationship between computer programming and learner's self-determination in learning, as Seymour Papert argued in his chapter "Computers and Computer cultures" [37], are a focal point for considering the learning content of such support. Moreover, the author argues that the ICT4D research approach is valid even in developed countries and that it should be pursued more actively, focusing not only on the diffusion of ICT infrastructure but also on the provision of educational support. The author believes that this study is a leading example of addressing this issue.

It must nonetheless be emphasised that this research is a qualitative study based on a small sample. One should therefore be cautious about generalising the research outcome. The results must be read critically, especially in light of different socio-cultural factors, diffusion of digital technologies, and educational circumstances surrounding digital skills and competencies.

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