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DISCOURSES IN COLOMBIAN AND SWEDISH SYLLABUSES

IS THERE ROOM FOR ACTION COMPETENCE BY MEANS OF STEM INTEGRATED COMPUTER PROGRAMMING?

DISCURSOS NOS PROGRAS DE ESTUDO DA COLOMBIA E DA SUÉCIA

Há espaço para a competência de ação através da programação de computador integrada em Stem?

DISCURSOS EN PROGRAMAS DE ESTUDIO COLOMBIANO Y SUECO

¿Hay espacio para la competencia de acción a través de la programación informática integrada Stem?

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RESUMO

Recentemente há uma tendência de inclusão de Programação e Educação Ambiental nos currículos nacionais devido ao acelerado desenvolvimento tecnológico e a crise climática. Este estudo tem como objetivo investigar se as noções de competência para ação, programação e educação ambiental convergem ou não nos Discursos dos documentos de política educacional da Colômbia e da Suécia. Competência para a ação é a capacidade de agir e tomar iniciativa de acordo com problemas importantes para os alunos. Os Discursos identificados são: (1) Qualificação é o que conta. (2) Programação tem pouco a ver com educação ambiental. (3) Os alunos não tomam decisões.

Palavras-chave: educação ambiental. currículo. tecnologias.

ABSTRACT

Recently there has been a trend to include Computer Programming and Environmental Education in national syllabuses due to the accelerated technological development and the climate crisis. This study aims to investigate how notions of Action Competence, Computer Programming and Environmental Education converge or not in Discourses in educational policy documents in Colombia and Sweden. Action Competence is the capacity to play an active role and act intentionally in addressing issues that matter to students. The Discourses that we identified are: (1) Qualification is what counts, (2) Programming has little to do with environmental education, and (3) Students are not decision makers.

Keywords: environmental education. curriculum. technologies.

RESUMEN

Recientemente hay una tendencia por la inclusión de Programación y Educación Ambiental en los planes de estudio nacionales debido al acelerado desarrollo tecnológico y a la crisis climática. Este estudio tiene como objetivo investigar si las nociones de competencia para la acción, programación y educación ambiental convergen o no en los Discursos de los documentos de política educativa de Colombia y Suecia. La competencia para la acción es la capacidad de actuar y tener iniciativa conforme a los problemas importantes para los estudiantes. Los Discursos identificados son: (1) Cualificación es lo que cuenta. (2) La programación tiene poco que ver con la educación ambiental. (3) Los estudiantes no toman decisiones.

Palabras clave: educación ambiental. plan de estudios. tecnologías.

Introduction

The 4th Industrial Revolution (including for example artificial intelligence, "smart" devices and the internet of things and people) which we are currently experiencing (Braidotti, 2019) is based on the development of skilled computer programmers. A good supply of programmers influences technological and financial developments worldwide. Hence, recently there has been a trend to include computer programming in K-12 curriculum around the world (Waite & Sentance, 2021). Arguments for including programming in curricula from the early years for all students are often developed around notions of the computationally literate and problem-solving citizen (Tissenbaum et al., 2019). At the same time as we are experiencing 4th Industrial Revolution, we are in the midst of the 6th Extinction due to human caused climate change (Braidotti, 2019). The climate change crisis is caused mainly by the Global North, but it is the Global South that so far has suffered the most from its consequences. Countries in the Global North have financial and technological resources to reduce the consequences of climate change. Countries in the Global South often lack such recourses and thereby become more vulnerable (IPCC, 2022). As a response to climate change, environmental education and actions for sustainable development are on the agenda and in syllabuses worldwide (Rieckmann, 2017).

To handle the complexity of the multidimensional issues which follows from the global climate crisis, integration of several disciplines, concepts and skills are required (Roehrig et al., 2021). In the educational realm, project based Critical Mathematics Education (Mellin-Olsen, 1987) (CME) could integrate several school subjects (e.g., STEM integration) to face complex uncertainties of the global crisis to support students to cope with and act on their anxieties about, and hopes for the present and the future (Branchetti et al., 2018). Action Competence (from now on AC) captures the capacity to act according with our intentions (Mogensen & Schnack, 2010). AC fits within an action-oriented teaching-learning approach which could support students to play an active role in addressing environmental issues in their local contexts. Moreover, AC is a key concept which seek to be critical in Environmental Education. AC relates to the framework developed by Barwell and Hauge (2021), that reflects several principles such as an active participation, the use of problems that matters to students and the communication of mathematical ideas in debates regarding climate change. Considering the above, we became intrigued to investigate how AC, Computer Programming (CP) and Environmental Education (EE) may or may not converge in discourses in educational policy documents in Colombia and Sweden. By identifying Discourses in syllabuses, it is possible to illuminate for granted taken assumptions that govern for instance teaching and learning. For granted taken assumptions project norms and values (Gee, 2010) that enables or restricts particular kinds of teaching-learning approaches such as action-oriented teaching-learning as part of CME that could foster AC. We ask; *How do AC, Computer Programming and Environmental Education converge or not in Discourses in educational policy documents in Colombia and Sweden?*

Educational policy in Colombia and Sweden

In this section we describe how Environmental Education (EE), and Computer Programming (CP) have been implemented in Colombian and Swedish educational policy. We chose to focus on syllabuses from Sweden (Global North) and Colombia (Global South) for several reasons. First, Lucely (the first author) has experiences with the Colombian educational system as a student, parent, and teacher. Ulrika (the second author) has the equivalent experience with the Swedish educational system with the addition of experiences as a teacher educator. Second, Colombia is at the bottom of world rankings while Sweden is at the top when it comes to for example Gross National Income per capita (The World Bank), emissions of CO_2 per capita (United Nations Environment Programme, Emissions Gap Report 2022) and scores at PISA tests (OECD, 2019). These differences indicate how the two countries differ in responsibility for global warming, vulnerability to its consequences and in possibilities to facilitate CP and EE.

In Colombia, international and national non-educational policies related to EE has influenced the integration of environmental issues in the school curriculum. There are some programs that are designed to encourage EE. One of the most important mandatory pedagogical projects included in the Colombian curriculum is School Environmental Project (PRAES in Spanish). This project must be implemented in every school and aims to promote environmental actions such as planting trees, starting school gardening, recycling etcetera. (Mejía-Cáceres et al., 2021). Some studies problematize unsuccessful implementation of EE policies in secondary school curriculums and the development of EE in Colombian context (Hueso & Arce, 2019; Pérez-Vásquez et al., 2021). CP is not mandatory in Colombian School. However, there are programs to encourage CP, such as "Coding for Kids" and "Green TIC". While Coding for Kids is targeted only in programming, Green TIC uses CP to achieve a set of environmental goals. Despite that CP is not included in the Colombian syllabuses due to the lack of technological resources in Colombian schools, some un-plugged activities are proposed that can somehow enhance the development of computational thinking skills.

In Sweden, Environmental policies in education have been integrated in the syllabus for science education in compulsory school and has been included not only to national culture but, as part of a process of cultural globalization (Hillbur et al., 2016). Since 2017, CP is explicitly included in the technology and mathematics curriculum in Sweden as a mandate from the Swedish Agency of Education (Vinnervik, 2020). Husamah et al. (2022) conducted a literature review about AC and EE over the last three years which reveals that research on this topic mainly comes from European countries. According to the study, Sweden is one of the countries which integrate EE and sustainable development in several subjects within the compulsory school curriculum highlighting competences such as critical thinking and democratic action competence. Challenges with positioning CP interdisciplinary have been reported (Isaksson Persson, 2022) for example in project based CME (Mellin-Olsen, 1987).

Action Competence, Environmental Education and Computer Programming

The notion of AC should be seen as an ideal in democratic approaches to education (Jensen & Schnack, 1997). Students should be able to make decisions about what and when they want to take part, for instance in democratic school activities, or community issues (Ryan & Steffensen, 2021) or in mathematical activities that involve climate change, where teachers should provide opportunities to enable an active participation (Barwell & Hauge, 2021). AC as an educational ideal is aligned with other concepts such as emancipatory education, democracy, human rights and sustainable development (Mogensen & Schnack, 2010, p. 61).

> [AC] cannot be reduced to mere education in the sense of cultivation, normalization, or traditional socialization. On the contrary and in concert with the utopian dimension of critical theory, it has as its aim the fulfillment of humanity: full development of the capacities and powers of each human individual to question preconceived opinions, prejudices, and 'given facts', and intentioned participation in the shaping of one's own and joint living conditions.

Ideally, an action competent individual can use resources such as the several skills they learn, the ability to question given facts and the capacity to act intentionally to build a more sustainable world. This involves students' full range of knowledges, attitudes, skills, and values to facilitate actions related with real-world sustainability issues and the confidence and willingness to act. In this sense, the three domains of educational purpose (Biesta, 2015) play an essential role in reaching the AC educational ideal since qualification, socialization and subjectification involves knowledge, traditions (ways of being or doing), and initiatives of students, respectively. Thus, the balance between the three domains can facilitate the development of AC. The notion of AC captures the call for the integration of several disciplines (Roehrig et al., 2021) to address the complexity of the climate crisis. A CME for climate change framework (Barwell & Hauge, 2021) is an example of such integration. It involves an important element of AC such as the capacity to take action by working on authentic problems that students find relevant. Working on problems that matter to students can generate motives to take action. Jensen and Schnack (1997) developed criteria for the notion of action in school activities. They claimed that action necessarily includes that students are involved in deciding what to do and that the activity is targeted at solving a problem. CME has much to offer in connection to the notion of AC and in relation to EE and CP because it can provide pedagogical designs for critical scrutiny which may spark action (Barwell & Hauge, 2021). The influence of computer algorithms has been critically investigated for instance from the perspective of how they black-box distribution of power and responsibility (Skovsmose, 2007) and how they operate as echo chambers (Parra, 2021). From an affirmative perspective CP can sustain the development of so called Green Innovation including for example open water plastic collecting drones (https://www.euronews.com/green/2022/06/17/these-drones-are-swallowing-tonnes-of-plastic-waste-before-it-reaches-the-ocean). AC in relation to CP includes the notion of students' computational action as meaningful and motivating rather than as just being part of uncritical academic tuition (Tissenbaum et al., 2019).

Theoretical considerations

To investigate how AC, CP and EE may or may not converge in discourses in national syllabuses in Colombia and Sweden we draw on Gee (2010) Discourse analysis. Discourses play a significant role because through them we can understand how meaning is built for example in policy documents. Discourses with a big D are the (implicit) meanings that are built through the language-in-use, i.e., through the words written in syllabuses. Discourses aren't merely language-in-use, they include who communicates, what is being communicated and what is done in socially situated activities. Through deconstruction of language-in-use it is possible to identify Discourses. To deconstruct language-in-use, questions about some or all building tasks used to construct "realities" through communication can be asked (Gee, 2010). Here we use three building tools (*significance*, *politics,* and *connections*) to identify Discourses in the national syllabuses. In connection to the three building tools, we ask Discourse analysis questions to understand what specific pieces of language say about specific areas of reality (Gee, 2010). In the present study a focus on the three building tools allows us to identify what policy makers find important for students to have, what education should provide and how they consider possible connections among AC, CP, and EE.

The *significance* tool recognizes what is rendered significant (and not) in the syllabuses in relation to AC, CP, and EE. The question of inquiry is: *How is this piece of language being used to make certain things significant or not and in what ways?*

The *politics* tool recognizes what is worth to have for students in the math, science, or technology subjects. The question of inquiry is: *What perspective on social goods is this piece of language communicating?*

The *connections* tool recognizes how some pieces of language connect or disconnect things. The question of inquiry is: *How does it make one thing relevant or irrelevant to another?*

Methodology

Data material

The data material that we used for analysis was Science (52 pages), Mathematics (27 pages) and Technology (22 pages) syllabuses for primary and secondary school which were stipulated for the National Agency of Education in Sweden and Colombia (MEN, 2006). The educational policy documents issued by the two countries' governments respectively are intended to shape classroom practices in both countries. The general structure of them is similar. They describe the aim of the subjects (science, math, and technology), the subject contents and the assessment orientations. However, Swedish curricula have a more fixed structure throughout the subjects.

Methods of analysis

First the Colombian and Swedish mathematics, science and technology syllabuses were read carefully. Swedish syllabuses and quotes from Colombian curriculum in this paper were translated into English by the authors to obtain an accurate translation. Then we conducted an iterative, abductive analysis process that moved among the first two steps described below to code the data material in the software NVivo. This software helps us to organize the information given in the syllabuses and facilitates the exploratory analysis. Both syllabuses were coded in the same project but as different cases (Colombian and Swedish cases). This allowed us to analyze the results both merged and separated.

The first step of the analysis was to identify codes that related to AC, CP, and EE. This step comprised careful and reflective reading of the documents developing initial codes and taking reflective notes while at the same time drawing on Jensen and Schnack (1997) criteria for AC. This procedure resulted in a distinction between what students should know and what they should be able to do to distinguish action. Hence, we used the codes *to know* and *to do.* Since action competence is about making decisions and solving problems, we decided to use the codes *make decision* and *problem.* In AC, the decision making relates to environmental and societal issues, so we decided to use the codes *society* and *environment*. Finally, we decided to use the code *programming* to enmesh CP in the documents.

The second step was made by means of the digital software NVivo. This process was an iterative dragging and dropping. Namely, dragging the portion of text in the document and dropping it to each related code. For example, one of the fragments of the text coded under *to know* was: "*Natural numbers and their properties and how the numbers are divided and used to indicate number and order".* (Skolverket, 2022, p. 55). This fragment is part of the mathematical content in Swedish curriculum. The next fragment from Colombian technology curriculum is an example of what was coded under *programming: "I assemble systems following instructions and schemas".* (MEN, 2008, p. 22)

In *the third step* we used explorative cluster analysis and charts from query results in NVivo to explore patterns and subsequently construe Discourses by means of the building tools proposed by Gee (2010). Cluster analysis and query results in NVivo transform qualitative data into quantitative variables (Jackson & Bazeley, 2019) and are part of the explorative process that provoke ideas and inferences but not final conclusions. Quantitative variables can show the code frequency in the data material. The more often they appear the more important (*significance tool*) and worth having (*politics tool*) they are being made through the language-in-use in the data material. By means of the explorative cluster analysis in NVivo it is possible to perceive similarities between the selected codes. These similarities are calculated by comparing the amount of similar (or different) text coded in a specific code.

Results

When we explored the data material in NVivo we tried the cluster analysis tool focusing on code similarity. The diagram displayed in figure 1 appeared. The diagram shows some codes as clustered together and other as further apart. According to this, the code *programming* and the other codes regarding AC do not seem to have similarities. The diagram suggests that *programming* is not so connected to the other codes. This intrigued us to further investigate how the different coded sections appeared as part of each other or close to each other (or not) in the documents. For example, if the codes environment and programming appear in the same section of the document then they are closely connected. We found that programming was not specifically connected to AC in the policy documents. The code *make decisions* does not often appear close to the other codes. Consequently, we infer that the development of the capacity to make decisions is not specifically connected to society, problem solving, environment and programming. In other words, since the criteria decision making is significant for AC but disconnected from what the decision making is about in AC, AC appears to be made insignificant in the syllabuses.

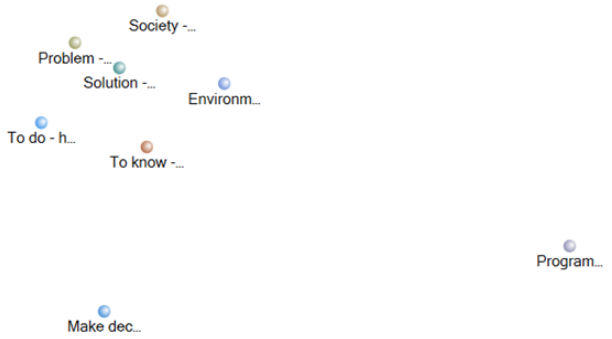

Figure 1: NVivo Cluster analysis.

A result from the NVivo analysis is the comparison chart in figure 2. This figure shows the frequency of each code in the Colombian and Swedish syllabuses. One of the most frequent and therefore most significant code in both countries was *to know.* Consequently, we construe "knowledge" or to use the words of Biesta (2015) qualification, as significant in the mathematics, science, and technology syllabuses in both countries. The NVivo analysis shows low frequencies of the codes *to do* and *make decision* in both contexts. Thus, the development of students decision-making abilities is made insignificant in the documents. Finally, the code *programming* has the lowest number of occurrences in both syllabuses. However, the mere fact that programming as a content appears in both countries' syllabuses when considering what could be made significant or not by in/or exclusion in the syllabuses we recognize that all of what is mentioned is significant to some extent.

	A : Colombia	B : Sweden
1 : To know	114	145
2 : To do	36	27
3 : Solution	78	46
4 : Society	59	38
5 : Problem	71	25
6 : Make decision	20	40
7 : Environment	65	57
8 : Programming	3	10

Figure 2: NVivo Query results of code frequency

The construed Discourses after the process were: (1) *Qualification is what counts*, (2) *Programming has little to do with environmental sustainability*, and (3) *Students are not decision makers*.

Qualification is what counts. This is the dominant discourse in the data material of the study. Syllabuses in Colombia and Sweden emphasize the qualification of students and the accumulation of knowledge. For example, the Swedish mathematics syllabus says: "The teaching should contribute to the students

developing knowledge to be able to formulate and solve problems as well as reflect on and evaluate selected strategies, models, and results. The students must also be given the conditions to develop knowledge to be able to interpret every day and mathematical situations and to describe and formulate these using the expressions of mathematics" (Skolverket, 2022, p. 54). The Colombian syllabus states: "In their (the learners) experiences within the pedagogical practices, knowledge arise in learners as the more efficient tool to solve related problems in the practices". (MEN, 2006, p. 72). Both syllabuses emphasize the development of knowledge to be able to interpret, describe, formulate and to solve problems within arranged educational situations. Thus, the development of knowledge is linked with the capacity to enhance problem-solving. Of course, knowledge is central to education and knowledge could motivate action. However, knowledge as such does not assure the decision-making capacity.

Programming has little to do with environmental education. As shown above, there are less similarities between the code programming and other codes. This suggests that programming is not so closely connected to the other codes. However, we could find some sentences that open the possibility to connect CP and EE in both syllabuses. The Swedish Technology syllabus says: "Students must be given opportunities to develop an understanding that technology is important to and affects people, society, and the environment. In this way, students can develop a technical awareness and an ability to relate technical solutions and their own use of technology to issues related to sustainable development". (Skolverket, 2022, p. 257). Colombian Technology syllabus states: "I identify some environmental and health consequences due to the use of technological products" (MEN, 2008, p. 17) . We can see here that there is an awareness regarding how technological developments can affect the environment in a positive or negative way. However, programming is not explicitly mentioned as part of 'technology'.

Students are not decision makers. There are few connections between the codes to-know and make decisions. Apparently, the qualification discourse is not connected to the capacity to make decisions. We can see from the Swedish math syllabus: "The student mainly chooses and uses working mathematical methods to make simple calculations with natural numbers and solve simple routine tools with satisfactory certainty". (Skolverket, 2022, p. 60). The quote implies that decision-making is strictly regulated within mathematics itself, rather than real-life situations. Colombian syllabus states: "The design of mathematical situations that allow students to make decisions is stressed" (MEN, 2006, p. 73). In this sense, the intention is that students have opportunities to practice decision-making. Figure 2 shows the lack of coded text associated with make-decisions, which suggests that decision making is made insignificant in both countries' syllabuses. Hence, the ability to make decisions, which is a pivotal part of AC, is made insignificant in the syllabuses.

Discussion

This study investigates how AC, CP and EE may or may not converge in discourses in national syllabuses in Colombia and Sweden. Through Gee (2010) discourse analysis, we identified the following discourses: (1) *Qualification is what counts*, (2) *Programming has little to do with environmental sustainability*, and (3) *Students are not decision makers*. *Qualification is what counts* resonates with Biesta (2015) words with respect to the aim of education and what education should produce. According to Biesta (2015) the three domains of educational purpose: qualification, socialization and subjectification need to be balanced in pedagogical practices and curricula. The Discourse *Programming has little to do with environmental sustainability* indicates that CP and EE have been included to some extent in syllabuses in Colombia and Sweden but there are not related to each other. The Discourse *Students are not decision makers* shows that the cultivation of AC is not one of the intentions of syllabi. (Jensen & Schnack, 1997). Then, despite that there are some components of AC in the syllabuses, there is a lack of text in the curriculum that captures the AC ideas which includes its several components. The Discourse *Qualification is what counts* seems to be the base of the two others. This means that since qualification is the dominant discourse within both curricula, it appears to be an imbalance between the three domains of educational purpose. Despite Colombia is a country of the Global South and Sweden is a country of the Global North, it seems that both educational systems have focused on the academic

achievement and need to prove that learners are skilled, especially for the national and international tests. However, there are considerable differences in PISA scores between both countries. The second discourse makes evident that CP and EE are in the curriculum, but with different paths or with aims that are not connected. One reason could be that the traditional organization of content in subject-matter do not allow the unification of efforts to build overall solutions to educational issues. CME (Barwell & Hauge, 2021) could provide opportunities to policymakers, principals, and teachers to consider environmental issues such as climate change from a more integrated perspective. Thus, we can think of, for instance, how mathematics made possible the development of CP and reflect about how mathematics and CP have contributed to climate change and how paradoxically could contribute with solutions. CME could offer a critical approach to Environmental issues that matter to students; therefore, this critical approach could foster AC.

It is important to mention that this study is limited to Colombia and Sweden; one country in the global north and one country in the global south. Despite the societal and economical differences, the syllabuses show similarities regarding the exploration of AC notion and the connections between CP and EE in syllabuses. One reason could be that most of the countries in the global south adapt curriculums and syllabuses from the global north to broad upper secondary education possibilities for their citizens. The Discourses that we found in the study are relevant in relation to the aims of education in this evolving, changing, and accelerated world. Nowadays we could build a better education for all focused in our planet and the possibilities that we have with critical and affirmative understandings about science, mathematics, and technology developments.

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