CODING FOR CHILDREN – A WAY TO FULFILL THE AIMS OF THE OECD LEARNING COMPASS 2030?

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Abstract

In recent years two kind of publications were observable: On the one hand, there were many contributions arguing why every child should learn to code. Beside fascinating and motivating children for STEM (Science Technology Engineering Mathematics) topics and giving a good career preparation, coding also can strengthen general skills like e.g. resilience, creativity and organization. On the other hand, there exist several publications by the OECD (Organization for Economic Co-operation and Development) describing future skills for children as well as issues of future education and work. Particularly the OECD has developed the "OECD Learning Compass 2030". This work is divided into several concepts. Each concept describes different skills being relevant for the children future.
In this contribution, we want to compare, contrast and merge these two fields of publications. Therefore, we examine an extensive literature review and give an overview about skills that can be imparted by teaching children to code. Then we take a look at OECD's compass and general skills. Therefore, we analyze the publications of OECD and apply text extraction to get relevant keywords of skills. Subsequently, we compare the coding skills with the OECD skills and look which aspects of the OECD compass can be fulfilled by teaching to code.
As a result, we can note that attaining many of the OECD future skills can be supported by teaching children to code. We also have identified which skills cannot covered by coding resp. which additional benefits knowledge in coding offers.
The paper concludes with a summary and an outlook. Future tasks are, e.g. examine at which age children should start learning to code, which are appropriate ways to teach and learn coding or concerning the question whether coding education should be realized as an one-size-fits-all approach or by applying internal differentiation.

Keywords: *Children, coding, future skills, OECD learning compass.*

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1. Introduction

In recent years two kind of publications were observable: On the one hand, there were many contributions arguing why every child should learn to code. Beside fascinating and motivating children for STEM (Science Technology Engineering Mathematics) topics and giving a good career preparation, coding also can strengthen general skills like e.g. resilience, creativity and organization. On the other hand, there exist several publications by the OECD (Organization for Economic Co-operation and Development) describing future skills for children as well as issues of future education and work. Particularly the OECD has developed the "OECD Learning Compass 2030".

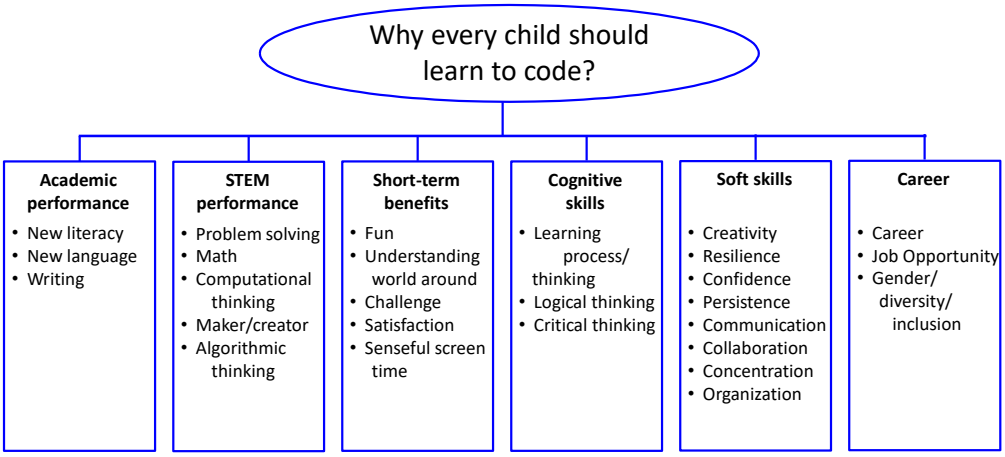
In this contribution, we want to compare, contrast and merge these two fields of publications. We want to show, which aspects of the OECD compass can be fulfilled by teaching to code and vice versa.

The reminder of the paper is organized as follows: section 2 describes the relevant literature and defines the objective. In section 3 we describe our process and the results. The paper concludes with a summary and an outlook in section 4.

2. Related work and objective

In recent years there were many publications about coding for children, as well in the scientific community (e.g. Mannova, 2022; Damla Kalyenci et al., 2022) as in internet blogs, newspapers and magazines. In Herden, 2022, we have read and analyzed many of these sources and summarized the reasons why children should learn to code. The result is depicted in figure 1.

Figure 1. Reasons why children should learn to code.



We have found 27 reasons and clustered them into the six groups academic performance, STEM performance, short-term benefits, cognitive skills, soft skills and career. Each reason and its relevance for learning to code is defined and described in Herden, 2022.

The OECD (OECD, 2019a) published its learning compass 2030. The learning compass is a framework for future education systems. The OECD choses the metaphor compass for the framework helping students to orient themselves and navigate through uncertainty towards well-being for themselves, their community and the society. An important design principle of the compass is to describe skills, values and competencies on an abstract level, the concrete implementation and interpretation should be realized in certain countries. So, the learning compass neither is a curriculum, moreover the usage is that countries take the compass as guideline for future curricula or check their current curricula against the aims of the learning compass.

The learning compass is divided into several concepts. Each concept describes different aspects and skills being relevant for the children future:

- The “Learning Compass 2030” (OECD, 2019b) gives a general overview of the documents.
- The concept of student agency (OECD, 2019c) is the core idea of the framework. It is rooted in the principle that students have the ability and the will to positively influence their own lives and the world around them. Student agency is thus defined as the capacity to set a goal, reflect and act responsibly to effect change.
- The three “Transformative Competencies” (OECD, 2019d) that students need for acting and designing the future are creating new value, reconciling tensions and dilemmas and taking responsibility.
- The "Core Foundations" (OECD, 2019e) are the fundamental conditions and core skills, knowledge, attitudes and values that are prerequisites for further learning across the entire curriculum.
- "Knowledge for 2030" (OECD, 2019f) are theoretical concepts and ideas as well as practical understanding and application. This knowledge is split into the four types disciplinary, interdisciplinary, epistemic and procedural knowledge.
- "Skills for 2030" (OECD, 2019g) describes some operative issues to translate ideas and knowledge into practice.
- For getting competencies besides knowledge and skills "Attitudes and Values" (OECD, 2019h) are also important.
- The "Anticipation-Action-Reflection" (AAR) (OECD, 2019i) cycle is an iterative learning process linked with the idea of continuous improvement of thinking and acting.

The objective of this contribution is to compare, contrast and merge these two publications.

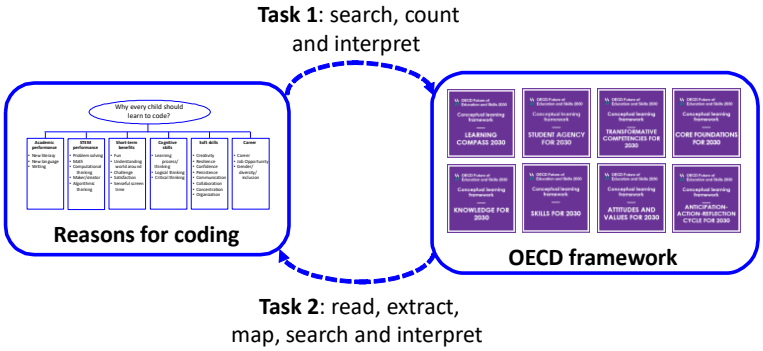
3. Comparing coding skills and the OECD compass

In this section we want to compare the reasons for coding with the OECD documents. This comparison is executed by the following tasks:

- Task 1: Every reason from Herden, 2022, is taken for a full text search in the OECD publications, we document the number of occurrence, distributed to each document. Finally, we give an interpretation of matching and missing entries.
- Task 2: By reading and analyzing the OECD documents we extract skills from them. We now look into the other direction by checking whether a detected skill is in Herden, 2022, or not. Here, we search for the extracted terms directly as well as mapped items to handle synonyms etc.

The tasks are summarized in figure 2.

Figure 2. Analyzed documents and tasks.



3.1. Task 1: Checking OECD publications for reasons

In this step, we take a look which of the reasons for children coding occur in the OECD framework. Therefore, for every reason we apply a full text search in each OECD document. The hits were postprocessed and some of them removed because they were duplicates or the same term occurred many times in the same context. We counted the reminding occurrences; the result is depicted in figure 3.

We can see that all groups of coding reasons are in the OECD documents, too. More in detail, 17 of 27 reasons were (directly or after mapping) found in the OECD documents, which is a fulfillment rate of 63%. Most hits got the reason groups STEM performance, cognitive skills and soft skills. The distribution over the parts of the OECD documents is not equally, most reasons were found in the four documents "Transformative Competencies", "Core Foundations", "Skills" and "Attitudes and Values".

The explanation for reasons not found in the OECD documents are manifold. For example, the rare occurrence of short-term benefits and the reasons career and job opportunity can be explained by the fact that these are operative items while the OECD compass focus on more general, strategic aims. On the other hand, computational thinking, algorithmic thinking and maker/creator are specific to coding at first glance but they important general future skills indeed (Wing, 2006). It seems that these aspects are underestimated in the OECD framework.

As a conclusion, we can record that coding reasons are important future skills.

Figure 3. Reasons for coding: occurrence in OECD framework.

	Learning Compass	Student Agency	Transformative Competencies	Core Foundations	Knowledge	Skills	Attitudes & Values	AAR	Total
Academic performance	0	0	1	6	1	2	2	0	**12**
STEM performance	0	2	4	6	7	5	2	0	**26**
Short-term Benefits	2	1	2	2	1	0	1	1	**10**
Cognitive skills	1	3	3	1	1	7	3	6	**25**
Soft skills	2	5	9	8	3	8	5	1	**41**
Career	2	0	2	0	2	0	7	0	**13**
Total	**7**	**11**	**21**	**23**	**15**	**22**	**20**	**8**	**127**

3.2. Task 2: Extracting skills from OECD publications

In this step, we want to examine which skills and competencies in the OECD documents can be reached by coding. Therefore, the OECD documents were read carefully and 136 skills were extracted. After reading we applied a postprocessing by mapping some terms to handle e.g. synonyms. 26 items had the same text and 68 after a textual mapping, the reminding 42 entries were not applicable.

The distribution of the found skills in the OECD documents and the distribution of their mapping to the coding skills is shown in figure 4.

Figure 4. Sills in OECD documents: occurrence in coding reasons.

	Total	Academic Performance	STEM performance	Short-term benefits	Cognitive skills	Soft skills	Career	Not
Learning Compass	**0**	0	0	0	0	0	0	0
Student Agency	**6**	0	0	0	0	2	0	4
Transformative Competencies	**33**	0	1	0	9	17	0	6
Core Foundations	**20**	4	1	1	4	3	0	7
Knowledge for 2030	**18**	1	3	0	3	3	0	8
Skills for 2030	**33**	1	3	0	7	8	1	13
Attitudes and Values for 2030	**26**	0	3	0	1	16	2	4
AAR Cycle	**0**	0	0	0	0	0	0	0
Total	**136**	**6**	**11**	**1**	**24**	**49**	**3**	**42**

As a result, the majority of extracted entries (69%) can be fulfilled by coding. The highest degrees of fulfillment are in the documents “Transformative Competencies” (82%) and “Attitudes and Values for 2030” (85%). The extracted entries are unequally distributed over the reason groups, most of them were found in the group soft skills. Some extracted skills do not occur in the coding skills, especially social emotional skills like empathy or sense of belonging.

As a result, we can say that many general skills from OECD documents can be supported by learning to code.

4. Summary and outlook

In this contribution we have compared publications about reasons why children should learn to code with the OECD learning compass. We applied this comparison by looking in both directions. As a result, we can record that there is a large overlapping in both directions. On the one hand, many of the reasons for coding can be detected in the OECD compass. On the other hand, many of the skills and competencies in the OECD compass can be fostered or fulfilled by coding skills. During the second task, we have found many general future skills that can be fostered by coding. In both tasks there remained reasons/skills that were not found. This is due to different reasons which we have mentioned above.

As future work different questions have to be tackled, e.g. examining which is the best age to start with coding or the question which tools are best depending on the child’s age.

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