CODESKILLS 4ROBOTICS

NATIONAL REPORT - SE

CODESKILLS4ROBOTICS: Promoting Coding & STEM Skills through Robotics: Supporting Primary Schools to Develop Inclusive Digital Strategies for All

IO1: Building the CODESKILLS4ROBOTICS Competence Framework: From Theory to Practice

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Executive Summary

Changes in, among other things, curricula, curricula and subject plans for primary and secondary schools will the school's mission to strengthen students' digital skills.

The changes relate to:

- that programming is introduced as a clear element in several different subjects in primary school, especially in engineering and mathematics
- that the pupils are strengthened in their source ability
- That students should be able to solve problems and put ideas into action in a creative way using digital technology
- students to work with digital texts, media and tools istudents to use and understand digital systems and services
- Students to develop an understanding of the impact of digitalisation on individuals and society

This report shows that:

The need for improved use of robotics in primary/secondary schools in Sweden are stressed by both students and teachers and will be crucial for development of STEM.

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1. Introduction

Digital competence is basically a matter of democracy. At school, we learn to understand the world in order to be able to change it. All children and students need to get an understanding of how digitalization affects the world and our lives, how programming controls the information flow we are reached by and the tools we use, as well as gaining knowledge about how the technology works to be able to apply it ourselves.

The goal of the government is that Sweden should be the best in the world using the possibilities of digitization. In May 2017, the Government decided on a single digitization strategy that spans several areas of society and provides an overall vision for the Government's digitization policy on a sustainable digitized Sweden. This strategy should be seen as part of a larger whole. The purpose of the overall strategy is that Sweden should continue to be a leader in digitalisation and be digitally competent. For this, the school system plays a central role by providing the opportunity to develop the ability to use and create with digital technology and understanding of how digitalization affects the individual and the development of society.

In the national strategy, the Government lays the foundation for the continued work to increase the goal fulfillment and increase the equivalence of the school system with the help of the potential of digitization. The strategy aims to ensure that all children and pupils, young and adults, get the knowledge they need for life and work life, which in the long run lays the foundation for the future supply of skills. It is about identifying new solutions that are made possible by digitization, assessing its relevance and then developing and using those that are relevant. It is also about having an ability to drive and lead development with the support of digitization.

A study from the Norwegian Media Council shows that the general access to digital tools and their use among children and young people differs according to gender, socio-economic background and other demographic variables. It is therefore important that all children and students are given the same opportunities to develop their digital skills.

This underlines the need for a national digitalisation strategy for the school system that can contribute to more systematic and strategic work throughout the school system and among all policymakers.

2. Coding, Robotics and STEM Skills in Primary Schools

The national digitisation strategy for the school system

On 19 October 2017, the government adopted a national digitisation strategy for the school system. The government wants the Swedish school to be a leader in using digitalisation opportunities in the best way to achieve a high level of digital literacy and to promote knowledge development and equivalence.

The strategy extends until 2022 and includes three focus areas, each with several milestones:

- Digital Literacy for everyone in the school system
- Equal access and use
- Research and follow-up on digitalisation opportunities.

Digitalisation in school – what does research say?

Increased commitment and interest in school work among students are positive effects of the use of digital tools. However, digital tools in themselves do not change, but only when they are used with a carefully thought-out pedagogy are positive results. It shows a literature review of the research findings about digitisation in school that education had allowed to do.

"It is important that reforms are based on accepted knowledge and digitisation in school is a neglected and very important area," says Lena Hallen Branch (S), Utbildningsutskottets chairman.

Betty Malmberg (M), who is the chairman of the Utbildningsutskottets Steering Group for follow-up and evaluation, shares the view that it is an important area.

"It's valuable knowledge for the Committee's work on issues related to digitisation in school," says Betty Malmberg (M).

Digital tools increase motivation in school

Several studies have shown that the use of digital tools, such as laptops and tablets, provides positive effects on both teaching and learning. The most common effects are increased motivation, increased engagement and increased interest in student studies, which is likely to lead to better study results. However, there are only a few studies where measurable positive effects have been proven. However, digital tools in themselves do not change, but only when they are used with a carefully thought-out pedagogy are positive results. There is still a need for more studies to highlight the effects with certainty.

Digitisation brings more challenges for teachers

Studies show that increased use of digital tools provides more challenges for teachers when it comes to managing classrooms and discipline. The use of digital tools can mean more distractions and risk of increased tempo and increased stress for students and teachers.

The research and evaluations that have been studied in this overview also show that skills development is needed at all levels for students, teachers and school leaders. This is important in order to create the conditions for good use of digital tools in teaching.

An important conclusion from the research is that It usage In school becomes increasingly a management issue. Changes in working methods give results and digital tool role is to make these new ways of working possible. New ways of working require organization, resources and competence.

The overview shows, in summary, that the use of digital tools in teaching has had an impact on pupils ' Result. However, there are only a few studies where the effects have been somewhat isolated, but they have shown positive results, such as The method of writing to read. There is still a need for more studies to highlight the effects with certainty.

Since access to and use of digital tools today varies considerably among Swedish schools, there are likely to be effects on the likvärdigheten. There are, among other things, Research showing that equivalence is affected depending on whether the digital tools are used with a thoughtful pedagogy or not.

Quality in Teaching and learners ' learning is influenced by digital tools. There are both positive and negative effects. When it comes to the quality of teaching, it is essential if the digital tools are used with a thoughtful pedagogy or not.

Increased use of ICT in school among students and teachers

Digital literacy is the extent to which one is familiar with digital tools and services and has the ability to accompany digital development and its impact on one's life. Education has recently reported that the use of it in school and It competency Among students and teachers has increased. The number of computers and tablets has increased greatly, improving the availability of students and teachers. In primary school there are about 1.8 students per computer and in upper secondary School 1.0 student per computer. Students ' use of it in the lessons has increased in all school subjects. A majority of pupils and teachers in primary school want to use the computer much more or more in school. It is most common for students to use it on lessons in Swedish and civic studies.

In both undergraduate and secondary schools, almost all teachers now have access to their own computer. Looking for information and reference material and creating assignments or tests for students are the most common tasks that teachers use it for. Teachers often use it for communication today. In general, teachers express a continued strong skills development needs in several itrelaterade Areas. Around half of the teachers in the primary and secondary schools experience a great skills development needs in these areas.

Increased engagement and interest among students

Several studies show positive effects on teaching and learning at school of the use of digital tools. The most common effects are increased motivation, increased engagement and increased interest in student studies, which is likely to lead to better study results. The use of computers provides more orderly work. It has become easier for teachers and students to keep track of their material, which has increased the conditions for better results. The pupil's time alone with the computer increases, which can have both positive and negative effects. There has been increased and better communication between teacher and pupil and between home and school. An increased use of digital tools gives a new perspective on school knowledge. Students are increasingly producing the knowledge themselves, rather than consuming it through printed learning materials. New skills and competencies can be developed via digital tools.

Improved study performance - difficult to measure

There have been several studies both internationally and in Sweden with attempts to measure whether the use of digital tools has affected study performance. There are few studies that convincingly show improved results in grades, samples, etc. After using digital tools. Explanations for this include the Research methodological limitations that make it difficult to securely determine the impact of particular digital tools compared to other factors influencing performance (social background, study habit home, gender, etc.). In addition, several knowledge and skills developed through digital tools are judged to lack clear, objectively measurable, quantitative measures. Another explanation is that it takes time to carry out such comprehensive reforms as are necessary to determine changes in study performance. The introduction of digital tools with associated thoughtful pedagogy requires at least three years, according to some even up to ten years, before results can be expected. Since it is only in recent years that more extensive efforts have been made, the effects on study performance can only be read after a few years.

More distractions and risk of increased tempo and increased stress

Studies show that increased use of digital tools provides more challenges for teachers when it comes to managing classrooms and discipline. When dryer tight or when the work becomes too difficult and the pupil does not know how to move forward, it is easy to do something else. When you have a computer in front of it, there are social media, games and an infinite number of websites to enjoy. The increased use of digital tools means increased workload for teachers. Unless special efforts are made from the principals, investments in digital tools will increase costs that may need to be financed through reduced teacher resources. The use of digital tools can mean that the tempo of teaching increases with the accompanying stress, for both students and teachers.

A new role for teachers – from teaching to learning

Studies suggest that the use of digital tools gives teachers a new role. This means a digital didactic thinking where the focus is shifted from planning teaching to planning for learning and going from lecture to tutoring. Teachers are given a better opportunity to continuously assess the pupil's individual level of knowledge and development and to provide feedback on work in progress (formative assessment), rather than that the pupil receives feedback only when the work is completed. Digital tools in themselves do not change, but only when they are used within the framework of a well-thought-out pedagogy are positive results. Digital technology acts as a lever for change, i.e. the Not as an independent force that drives change. If the digital tools are not used within the framework of a well-thought-out pedagogy, the results are expected to be worse.

Skills development is needed at all levels

The research and evaluations that have been studied in this overview show that skills development is needed at all levels – for students, teachers and school leaders – in order to create conditions for tech supported learning. Training is needed to enable students to use the computer more as an educational tool. The students are good at, for example, searching for information, but they need, among other things, Practice critically review information. Teachers need to develop skills and be given the opportunity to use the technology in a thoughtful way and design tasks so that the students in turn can use it in a thoughtful way. School leaders need skills development to be able to control digital investments in a good way.

IT usage in school is increasingly a management issue

One important conclusion from the research is that it is the changing ways of working that produce results. Digital tool role is to make these new ways of working possible. New ways of working require organization, resources and competence. What to do, what technology and what other resources are needed to do so, and how can it be done in the most efficient way; All these are questions that the individual teacher or teacher team alone can answer. It usage In school is increasingly a management issue. Research shows that if school leaders are clear and active in the integration process, implementation is better able to succeed

Programming important in a digitisation strategy

All children in Sweden will learn programming from the autumn semester 2018. And Sweden is in no way first with the idea – but how well thought is it, and how has the outcome become in the countries that have gone before?

From this autumn, programming is included in primary school, especially in the subject of mathematics and technology. The idea behind is that today's students live in an increasingly digitised society and must be equipped for a reality in which over 90 percent of today's jobs require basic computer skills.

3. Empirical Research - Statistics

Results Questionnaire for Students

Demographics, 30 participants

1. Gender

Boy (17)

Girl (13)

2. Age

8 - 9

10 - 11

12 - 13 (30)

3. School

In an urban center

In the province (30)

Personal Interest - Attitudes

4. Do you know what Educational Robotics is?

Yes (8)

No (22)

5. How did you get informed about Educational Robotics?

I am not informed about Educational Robotics (22)

I found information on the Internet (5)

A friend of mine informed me

Through Computer Science classes at school

I participated in a Robotics program at school (3)

I participated in afternoon classes of Robotics (offered by the Municipality, the

Parents Association, etc.)

I participated or attended Robotics or Informatics Competitions or a Digital Creation Festival.

I attended private Robotics classes

Other

6. Are you interested in Robotics?

Yes (30)

No

7. Would you like to get a robot?

Yes (30)

No

8. Are you afraid or robots?

Yes (3)

No (27)

9. In your opinion, could a robot have feelings?

Yes

No (30)

10. Do you think the robots are smarter than humans?

Yes (6)

No (24)

11. Have you tried, alone or within a group, to build or program a robot?

Yes (17)

No (13)

12. Which of the following verbs express your relationship with robotics?

Play (25)

Learn (25)

Explore (17)

Assemble

Construct (11)

Think

Count (10)

Imagine

Create (10)

Other

13. Which of the following sciences are, in your view, linked to robotics?

Engineering (Mechanics) (30)

Graphic design

Physics (15)

Medicine

Anthropology

Computer Science (30)

Biology

Maths (30)

Architecture

14. For which of the following reasons would you suggest to your friends to engage on robotics?

Entertainment (30)

Knowledge (30)

Development of thinking (30)

Collaboration (30)

Development of creativity (30)

Educational Robotics and School (30)

15. Do you attend Robotics classes at your school?

Yes (30)

No

16. Who teaches the Robotics classes?

I am not attending any Robotics classes at schools

Teacher of the class

Computer Science teacher

Other (30)

17. How often do you attend Robotics classes at school?

Less than 1 hour a week (30)

1 - 2 hours per week

3 - 4 hours per week

More than 4 hours per week

I am not attending any Robotics classes at school

18. In which of the following courses do you use Robotics?

Language

Maths (30)

History

Computer Science

Physics

Social and Politic Life

Religion

Geography

Other

None of the above

19. Why would you attend a Robotics class at school?

To learn new things (30)

To find out more abotr robotics (30)

To build a robot (30)

To learn how to program a robot (30)

To impress my friends

To work with other students

To improvise

To participate in a student competition or festival on Robotics or Informatics

To win a robot

A robot I would like to construct will ...

......

(Fill in your own idea...)

Results Questionnaire for Teachers

Demographics, 53 participants

1. Gender

Male (9)

Female (44)

2. Age

25 - 35 (10)

36 - 45 (14)

46 - 55 (22)

56 - 65 (7)

3. Years of service

1 - 10 (10)

11 - 20 (29)

20+ (14)

4. School

In an urban center

In the province (53)

Educational Robotics in Your School - Infrastructure

5. Which of the following facilities do you have at your school?

Computer for the teacher (53)

Computer for the students in the classroom

Computer Laboratory for students (53)

Internet Connection (53)

Interactive Whiteboard

Peripherals (projector, printers, scanners, etc.) (53)

Commercially Available Educational Robots (53)

Other

None of the above

6. In what ways is educational robotics taught in your school?

Supporting other lessons

In the lesson of Computer Science

In all day program (53)

After school/afternoon courses from various institutions (eg Municipality, Parent Associations, etc.)

Summer lessons from various institutions (eg Municipality, Parent Associations, etc.)

It is not taught

7. In what ways is IT (ICT) incorporated into your school?

Use of IT through other lessons (53)

Teaching computer use at regular intervals in the classroom

Teaching computer use at the Computer Laboratory

In the context of homework (eg search for information, preparation of presentation)

It is not incorporated at all

Knowledge Concerning STEM Education and Educational Robotics

8. Do you have knowledge in any of the following areas?

Not at all

Slightly (17)

Moderately (35)

Very (1)

Extremely

Science Computer Programming (eg

excel/scratch/programming

language)

Educational Robotics

9. How did you acquire this knowledge?"

Seminars (36)

Undergraduate studies

Postgraduate studies

Personal interest (for example studying educational material available online or

watching videos on YouTube) (17)

I do not have knowledge on Educational Robotics

10. Have you ever attended seminars on Educational Robotics?

Constructions, structure and functions of educational robots (sensors,

commands, etc.)

Educational robotics platforms or other environments (53)

Programming of educational robots

Utilization of educational robotics in the educational process

I have not attended any Educational Robotics seminars

11. Who provided the Educational Robotics seminars you attended?

Private Educational Provider

National Educational Provider (42)

Online Seminars (e-learning) (53)

I have not attended any Educational Robotics seminars

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12. Have you ever come into contact with STEM Education term (Science, Technology, Engineering, Mechanics)?

Yes

No (53)

13. Do you know how to integrate STEM Training into your lesson?

Yes

No (40)

I am not sure (13)

14. In which of the following ways do you consider you incorporate STEM Training into your lessons?

Use of materials that engage the senses

Use of electronic devices (computers, tablets etc.) (53)

Educational games (53)

Educational experiments (53)

Open discussions with students (53)

Use of problem-solving educational approach (53)

Use of extracirricular bibliography (magazines, books, etc.) (53)

Educational visits (53)

None of the above

Integration of Educational Robotics in the Classroom

15. Have you ever used educational robotics in your lesson?

Yes (42)

No (11)

16. At what age do you think it is appropriate to introduce Educational Robotics?

Between 6 and 9 years old (53)

Between 9 and 12 years old

Do not know/No answer

17. Which of the following reasons prevent you from using Educational Robotics in your lessons?

Lack of personal interest

Lack of interest by managment

Lack of infrastructure

Lack of training (53)

Uncertainty about using it effectively

Uncertainty about motivating and engaging students

Uncertainty about technical issues (constructions, functions, connections, etc.)

Lack of training time

None of the above

18. To what extent do you think that the use of Educational Robotics can help teach the following lessons?

Not at all

Slightly

Moderately

Very

Extremely

Language M (33) S (15)

Maths M (53)

Computer Science V (53)

Physics M (53)

Geography S (53)

History S (53)

Foreign Language M (53)

Arts (53)

19. To what extent do you think that the use of Educational Robotics can help students in the following areas?

Not at all

Slightly

Moderately

Very

Extremely

Collaboration S (42) M (11)

Imagination development S(42) M(11)

Creativity development S(45) M(8)

Fine motor skills -

Critical thinking S(40) M(13)

Problem Solving S(40) M(13)

Data analysis M(53)

Presentation skills in front of audience S(45) M(8)

Inventiveness S(40) M(13)

Development and enrichment of learning strategies S(40) M(13)

Enabling of expression of ideas and opinions S(45) M(8)

Active engagement of students in the learning process S(40) M(13)

20. In what way do you think that the Educational Robotics course could be included in your school?

Computer Science lessons

Project Work/Cross-curricular Work (53)

School Activities Program

Supporting other lessons (53)

In All Day School

After school/afternoon lessons from various institutions (eg Municipality, Parent Associations, etc.)

Summer lessons from various institutions (eg Municipality, Parent Associations, etc.)

21. Who do you think would be suitable to teach Educational Robotics at your school?

Computer Science Teacher

Teacher with specialty in Information Technology (eg postgraduate or other curriculum)

Teacher of the class with proper training (53)

None of the above

22. Would you like to use Educational Robotics to teach STEM skills?

Yes (53)

No

23. Add a comment

....

4. Results and Conclusion

The results of the survey among Swedish students are limited in scope but can still serve as a basis for further discussions. This also applies to the survey carried out among primary/secondary school teachers. The students show a fragmented picture of knowledge about robotics. Half of the students have not been allowed to take part in robotics at school and also lack information about the possibilities that can be found in this technique despite the fact that there is a great interest in learning more, all the students in the survey welcomed more information and that the technique was used in teaching.

There is generally a good knowledge of what robotics and robots stand for: a technique that should not be mixed together with people's emotions or intellect. Most students instead see robotics/robots as a playful way of learning. In teaching, the technique is linked to mathematics and technology.

All students participate in the teaching of robotics and programming, but teaching is limited in size, less than one hour per week. The results show that the pupils welcome robotics in the teaching and indicate that it certainly leads to increased knowledge. As far as the survey aimed at primary/secondary school teachers is concerned, it can be seen that all indicated that robotics equipment existed in schools for teaching and that robotics is used in all of the school's subjects and not only in mathematics and technology.

ICT, according to the teachers, is integrated into all teaching and it is evident that this also applies to robotics. It can be seen that although robotics is available in schools and used in teaching, the competence related to this amongst teachers are low. Teachers indicate that some training has taken place in limited seminars, workshops aso but there is also a large group of teachers who indicate that they have learned on their own, without the support of employers. The knowledge of the concept of STEM is practically non-existent, the concept does not seem to be used (also applies to translations of the STEM into Swedish). It follows that no one integrated this into their teaching. The term is thus unknown, but the concepts included are hardly unknown, they are described in the curriculum but the STEM does not exist as a concept.

Several have used robotics in their teaching, but they all indicate that their own competence is limited. In the teaching of different subjects in the school, all the teachers in the study describe that robotics can be used in all learning, i.e. not just mathematics and/or technology. Teachers highlight development in terms of cooperation, creativity, imagination as possible and see the ability to critically review facts as the most interesting development area. It follows that the majority see robotics as part of all forms of teaching and that teaching should be conducted by all types of teachers.

Some examples of how robotics and STEM can be integrated in schools:

KOMTEK:

A kick off for prospective technicians, scientists, innovators and entrepreneurs! Komtek, the municipal engineering and Entrepreneurial school, is no real school but a municipal activity with a focus on leisure courses and support for the school. To Komtek you come if you are curious and want to learn and explore. To Komtek, you will be if it itches in your fingers and brain. At Komtek are all ways to learn, all methods, right. Komtek is a place where everyone is welcome. A Komtek can look in many ways depending on the conditions and ambition of the own principal. Some Komtek are run entirely in municipal government, others to some extent with external financiers. Each Komtek is led by a director who is pedagogically active in the business, and participates in the national and regional Management group work. The driving force and strength of the Komtek are our employees ' commitment, collective competence, curiosity, joy and willingness to replenish and share this both to our participants but also in our network! Our methods are based on our being a codiscoverer on the journey, the entrepreneurial approach where test, try, try, nothing is wrong or impossible are keywords and obvious to us and the practical work where we use all the senses to learn and understand. Together we are 60 technology educators with a tremendous knowledge and education breadth. In addition to our regular staff, we have more than 250 hourly staff tutors. It can be students from high school or colleges, universities with their own interest in technology, entrepreneurship and pedagogy. Komtek is a great employer, and a great breeding ground for young employees on the way out into the world of work!

FAB LAB

Fab Lab is the educational outreach component of MIT's Center for Bits and Atoms (CBA), an extension of its research into digital fabrication and computation. A Fab Lab is a technical prototyping platform for innovation and invention, providing stimulus for local entrepreneurship. A Fab Lab is also a platform for learning and innovation: a place to play, to create, to learn, to mentor, to invent. To be a Fab Lab means connecting to a global community of learners, educators, technologists, researchers, makers and innovators- -a knowledge sharing network that spans 30 countries and 24 time zones. Because all Fab Labs share common tools and processes, the program is building a global network, a distributed laboratory for research and invention.

A Fab Lab is comprised of off-the-shelf, industrial-grade fabrication and electronics tools, wrapped in open source software and programs written by researchers at MIT's Center for Bits & Atoms. Currently Fab Labs include a laser cutter that makes 2D and 3D structures, a sign cutter that plots in copper to make antennas and flex circuits, a high-resolution NC milling machine that makes circuit boards and precision parts, a large wood router for building furniture and housing, and a suite of electronic components and programming tools for low-cost, high-speed microcontrollers for onsite rapid circuit prototyping. Originally designed for communities as prototyping platforms for local entrepreneurship, Fab Labs are increasingly being adopted by schools as platforms for project-based, hands-on STEM education. Users learn by designing and creating objects of personal interest or import. Empowered by the experience of making something themselves, they both learn and mentor each other, gaining deep knowledge about the machines, the materials, the design process, and the engineering that goes into invention and innovation. In educational settings, rather than relying on a fixed curriculum, learning happens in an authentic, engaging, personal context, one in which students go through a cycle of imagination, design, prototyping, reflection, and iteration as they find solutions to challenges or bring their ideas to life.

As support for advanced technical education and to provide a training path for new fab lab managers, Fab Academy, an internationally distributed campus for technical education, has emerged from the Fab Lab program. The Fab Academy provides instruction and supervises investigation of mechanisms, applications, and implications of digital fabrication.

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