

Teacher training in robotics – evaluating the implementation of robotics and teacher's motivation and self-efficacy towards robotics

PATT40 conference

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Agenda

1. On the project „Robonatives“ and its educational concept (JL)
2. Motivation and self-efficacy of teachers (JL)
3. Methodolgy (DH)
4. Results (DH)
 1. Motivation (DH)
 2. Self-efficacy (DH)
5. Conclusio and outlook (DH&JL)

Prelude

Starting point

- Shift towards Industry 4.0: Automation & IoT
- Numbers of Robotic systems in industry increased from 121,000 (2010) to 517,000 (2021) (Statista 2022)
- The essential role of understanding and interacting with robots for future generations

The Dichotomy of Robot Portrayal

- Media: Robots with superior strength, intelligence, and potential threats
- Reality: Robots designed for everyday menial tasks like vacuuming and mowing
- Key question: Bridging the gap between media portrayal and real capabilities

1. On the project „Robonatives“ and its educational concept

Problem

- No Widespread Technology Education in German Schools
- Lack of Equipment with Robotic Systems
- Teachers Were Only Superficially or Not at All Trained in Robotics During Their Studies
- **Competence centers** at 4 universities
- **Technology labs** at 54 general education schools
- **Robotics innovation and future centers** at 7 vocational schools
- **Innovation and future for nursing centers** at 4 vocational schools

Training programme

Course	Main content	Course	Main content
1	Commissioning of the robots, Teach&Playback, Safety instructions	6	Industry 4.0 and connected production using I/O ports and phototransistors
2	Introduction to visual programming with Blockly	7	Internet of Things via MQTT
3	Programming of end effectors and actuators	8	Use of a 3D printing module
4	Programming a linear axis	9	Programming the vision kit for object detection
5	Programming with Python	10	Programming the AI Kit

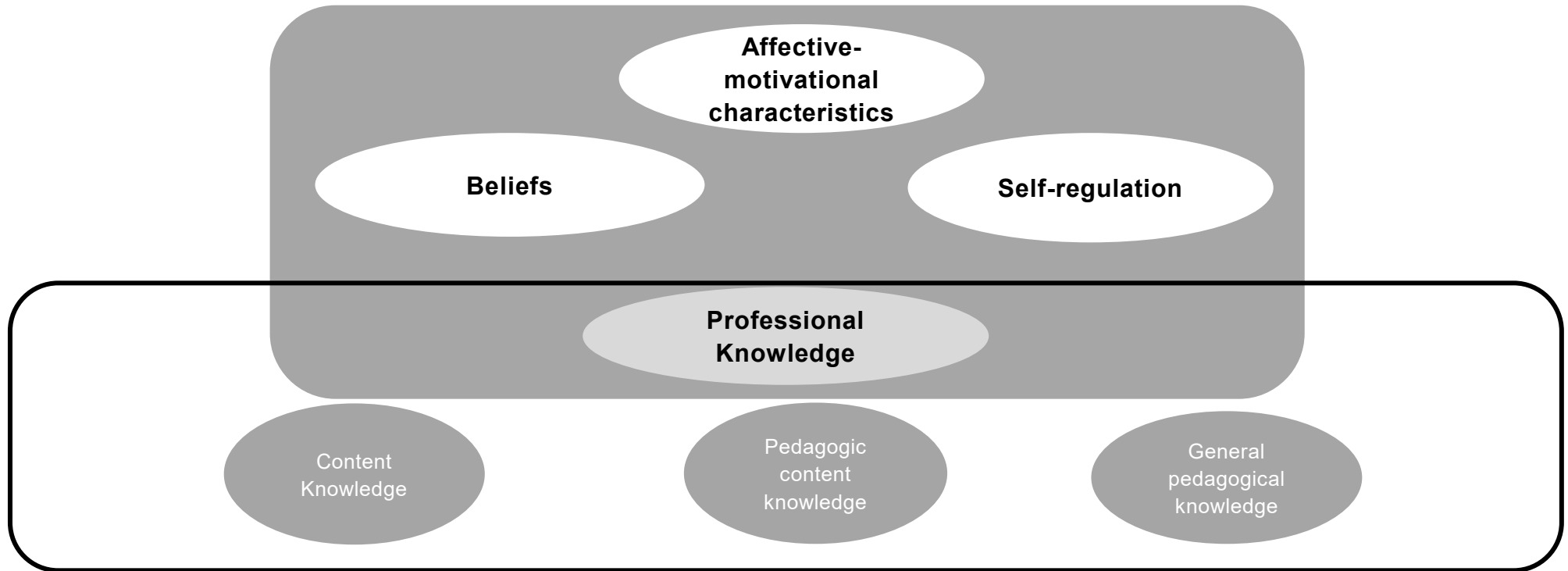
2. Motivation and self-efficacy

- Importance of teacher's knowledge, skills, motivation, and self-efficacy in the teaching process
- Strongly developed sense of self-efficacy leads to better student performance:

“Teachers who practice their profession with enthusiasm fulfill the task of teaching with higher quality and also achieve more favourable results with their students.” (Kunter 2011, 269, translation by the authors)

- Need for continuous professional development based on identified gaps and challenges

2. Motivation and self-efficacy



Kunter et al. 2011

3. Research Methodology

I To what degree were robotics curricula integrated into the funded schools?

II What robotics equipment was available in schools?

III What were the motivating factors behind teachers' efforts to teach robotics?

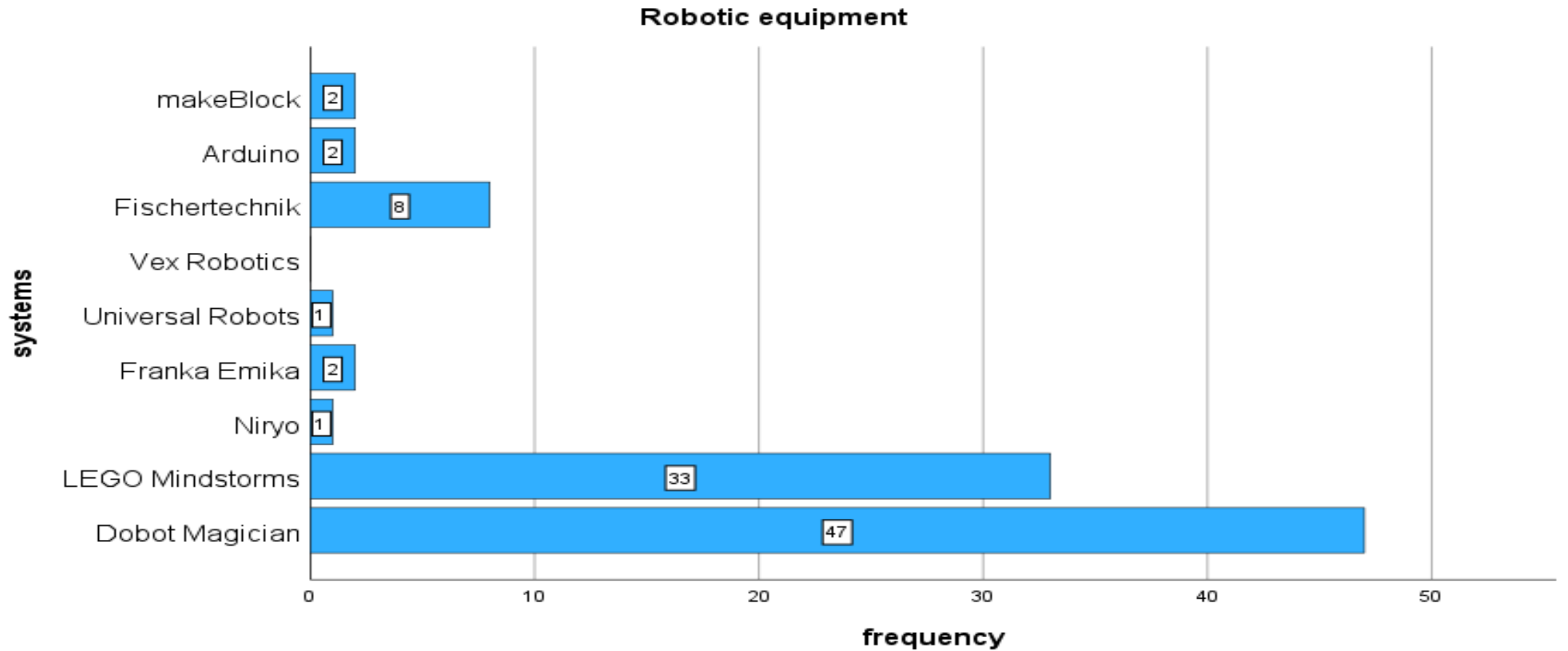
IV What attitudes did teachers have towards teaching robotics?

V What role does teacher self-efficacy play in their ability to teach robotics?

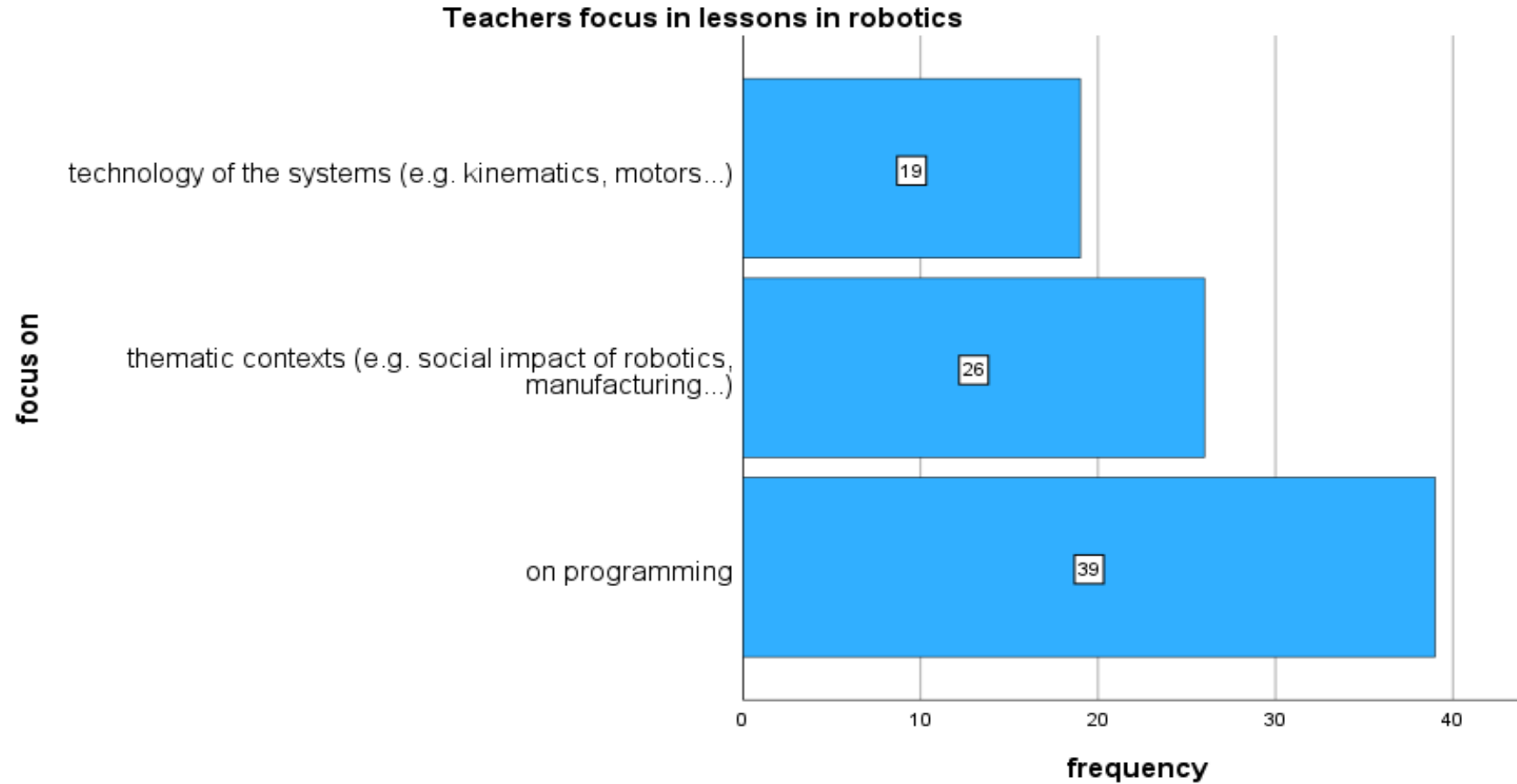
Data collection: Digital questionnaire distributed to project teachers, adapted from previous research and studies (N=49, 42 male and 7 female teachers).

Questionnaire: Basic demographic data, usage of the robots and teaching, attitude and motivation (Reinke 2022; Kunter et al., 2011), self-efficacy (Pfitzner-Eden, Thiel & Horsley 2014)

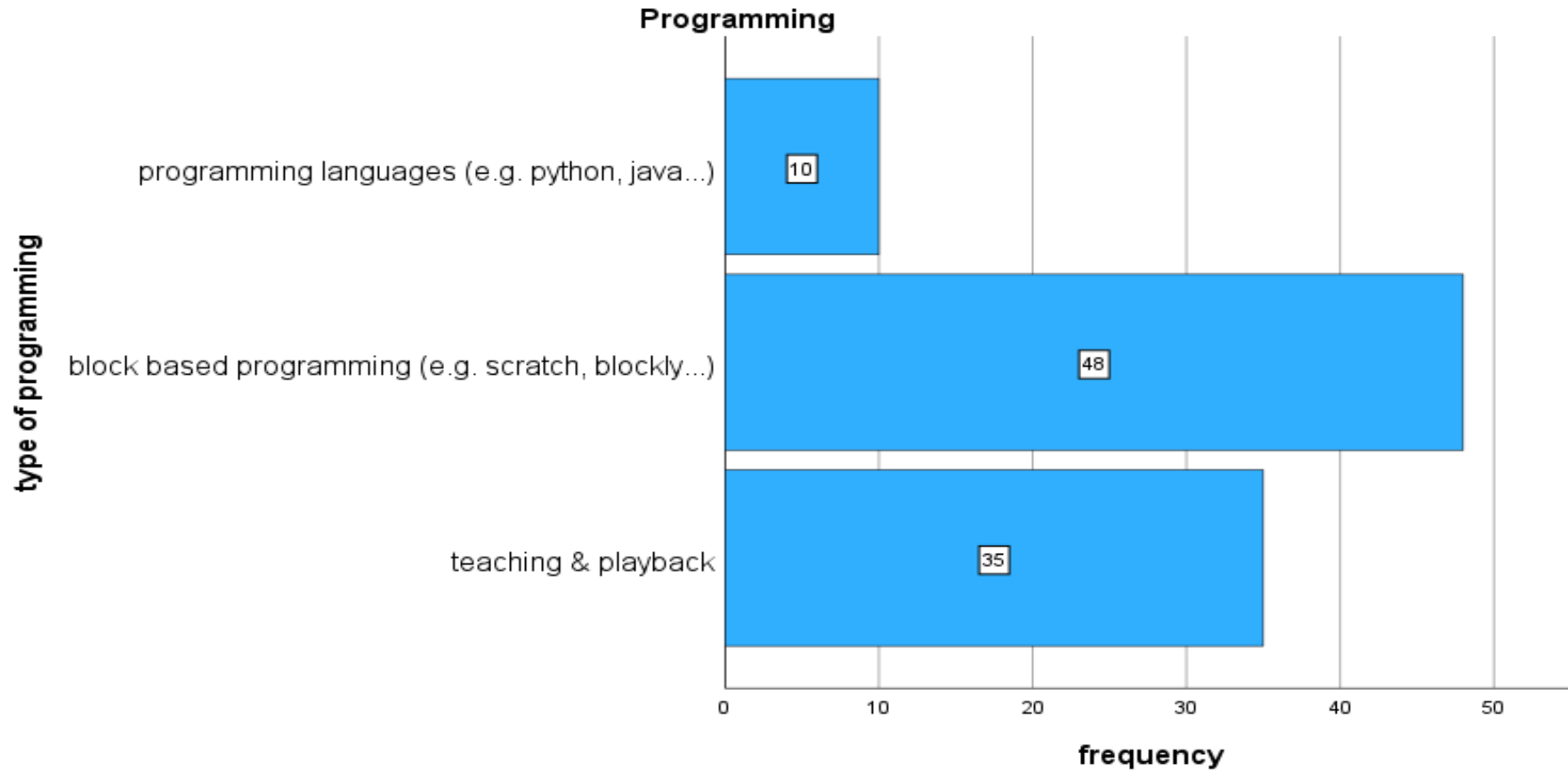
Robotic Equipment



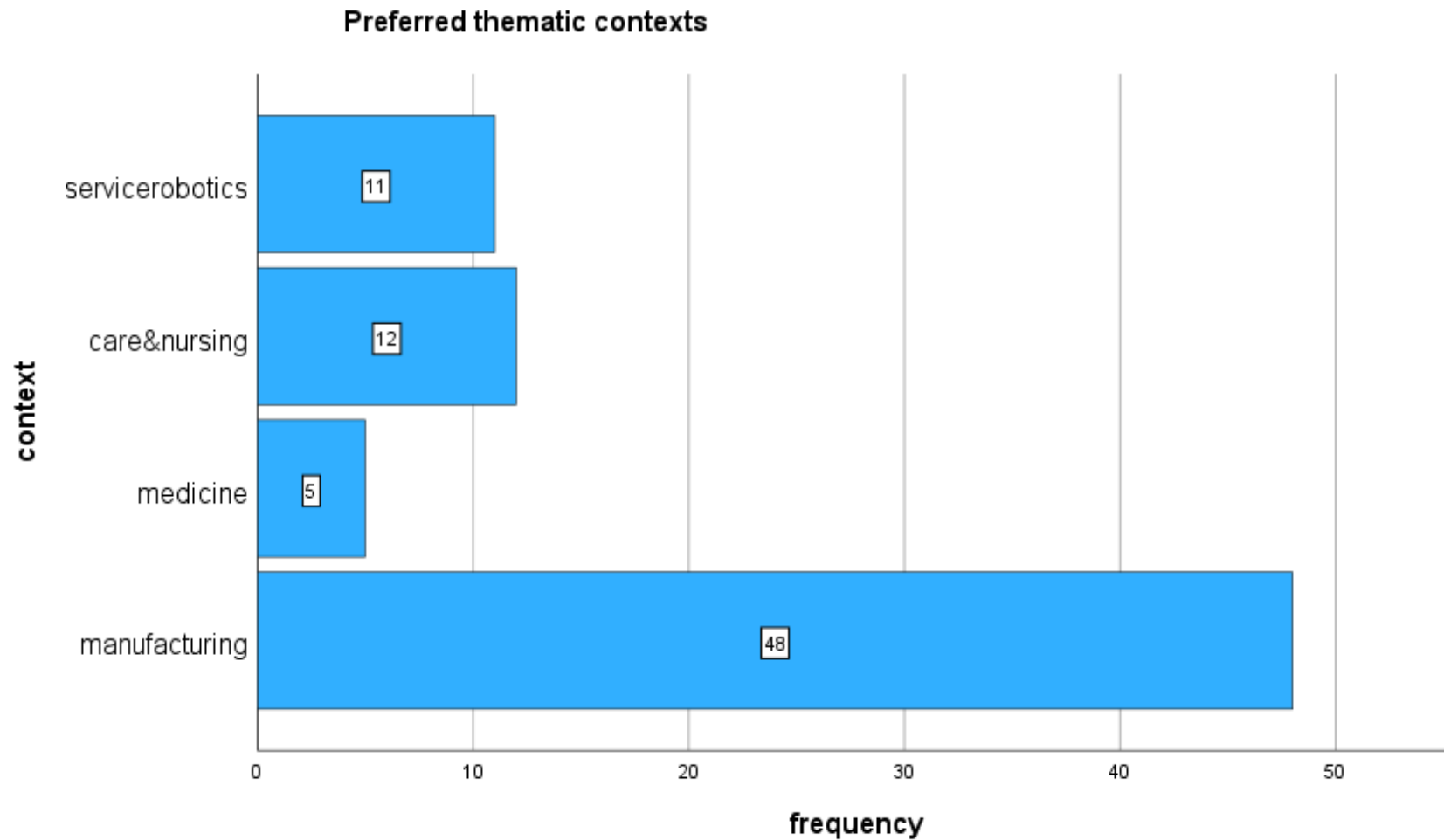
On what teachers focus in lessons



Programming languages used



Thematic context teachers prefer



Teachers motivation

Item	M	SD
I find the topic of robotics interesting.	1.24	0.43
The use of robotics in the classroom is an important concern for me.	1.29	0.46
I enjoy teaching content related to robotics.	1.41	0.54
Teaching technological progress in automation technology in the classroom is an important concern for me.	1.49	0.71
Too much emphasis is placed on the integration of robotics in the classroom in my opinion.	3.43	0.71
I think students get bored with robotics topics.	3.37	0.49
As teachers, we can help to get students more interested in robotics.	1.49	0.61
Classes can provide the thought-provoking impulses towards robotics that can influence students' career choices.	1.49	0.62
I think it's good that automation technology is finding its way into the classroom more and more.	1.57	0.58
Automation technology displaces classical teaching content, which means that students do not learn other important content.	3.12	0.81

– High level of motivation ($M=1,51$, $SD=0,34$)

Self-efficacy in handling the robots

Item	M	SD
I feel confident in programming the robots.	1.82	0.635
I feel confident in describing the kinematics of the robots.	2.22	0.771
I still feel very unsure about the basics of robotics.	3.27	0.7
I feel confident in solving technical problems on the hardware (e.g. error messages due to axis errors on the robot or compilation errors in the programming).	1.82	0.808

- Teachers feel generally confident handling the robots
- Describing the kinematics of the robots seems to be challenging

Self-efficacy in teaching situations

Item [I am sure that I will ...]	M	SD
... be able to find an alternative explanation or examples when students do not understand something about robotics.	1.96	0.706
... be able to adapt the level of challenge of teaching in the context of robotics to the achievement level of individual students.	2.06	0.719
... be able to assess the extent to which students can understand the robotics subject matter.	1.82	0.635
... be able to get students to follow rules in class (safety rules when using equipment).	1.29	0.456
... be able to teach students the fundamental importance of robotics in the classroom.	1.65	0.597
... be able to motivate students who have little interest in robotics.	2.29	0.764
... can also motivate students who often fail in automation technology topics.	2.20	0.763
... be able to promote critical thinking with regard to robots in pupils.	1.71	0.645

- Self-efficacy in teaching robotics is also relatively high ($M=1,87$ $SD= 0,39$)

Self-efficacy in planning lessons

Item	M	SD
I have problems finding suitable content for lesson planning on robotics.	2.71	0.816
I find it difficult to find appropriate contexts for robotics that encourage my students' interest in the content.	2.63	0.929
I need more training so that I can use robots safely in the classroom.	1.86	0.791

- Generally no difficulty in finding appropriate content and engaging contexts.
- *SD* very high, indicating that some teachers still find these areas challenging.

5. Conclusion and outlook

- Positive project outcome is that the majority of the teachers feel confident to integrate robotics into the schools own curricula.
- The teachers feel confident in handling the robots, what indicates, that the basic programme objectives are achieved
- Teachers need further training in instruction and planning lessons (thematic context, kinematics).
- In this regard it would be interesting to if there are gender specific effects
- The next step is to asses students attitude towards robotics (first steps were made with assesing students pre-concepts regarding robots)

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