A European survey on requirements for the informatics school curriculum and informatics school teachers' education

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by

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Executive Summary

This report describes the findings of a Europe-wide study done to identify shared requirements for informatics education in school.

The main finding is the effectiveness of the *Informatics Reference Framework for School* (IRFS), structured around 11 fundamental core topic areas, in providing a broadly shared perspective on informatics. Additionally, important common patterns emerged - despite significant variation across countries in terms of the varying emphasis on different aspects of informatics education reflecting their local priorities and contexts.

A broad consensus emerged for having 1-2 hours per week of informatics education in primary schools and 1-3 hours in lower secondary schools. There is also a broad consensus on the importance of the core topics of data and information, algorithms and programming which should receive 10-20% of instructional time each whilst the remaining 8 topics should receive 5-10% each. For contemporary themes, data science, programming languages and artificial intelligence/robotics emerged as top priorities.

Furthermore, there is a broad consensus regarding the importance of educating teachers in Pedagogical Content Knowledge (PCK) for informatics, so that they can implement effective pedagogical approaches for enabling students to develop their understanding and skills. The consensus is for 15-60 European Credit Transfer and Accumulation System (ECTS) credits for primary school teachers' pre-service education and 30-120 ECTS credits for lower secondary school teachers.

The *Informatics Reference Framework for School* (IRFS) is a document released in February 2022 by the Informatics for All (I4All) coalition, to provide high-level guidance for informatics curriculum designers in schools across Europe.

The framework, translated into multiple languages, outlines five core competency goals for students by the end of compulsory schooling. These include responsible and creative use of digital tools, understanding informatics principles, algorithmic problem-solving, developing computational models, and addressing ethical and social issues related to computing.

The IRFS identifies 11 core topic areas covering fundamental informatics principles, such as data and information, algorithms and programming. Additionally, 10 contemporary informatics themes, including AI, machine learning, and robotics, were identified aiming to support the interpretation of the IRFS in the context of recent innovations.

Following the Council of the European Union's recommendations in November 2023 for high-quality informatics education across Member States, to be delivered by qualified teachers, the I4All Steering Committee conducted a survey across Europe to investigate the extent to which it is possible, in the light of the diversity of educational systems, to identify common European guidelines for: (i) informatics education for students and (ii) the education of teachers for teaching informatics in school. For each country a single point of reference, either the person or committee responsible for school education issues within the national academic informatics organization (for countries where such organizations exist) or a relevant expert in the field was identified. These colleagues were asked to engage their national community of educators and experts, and provide, not their personal viewpoint on the matter, but a nationally shared perspective. The questionnaire survey focused on primary and lower secondary education and sought input on ideal teaching hours, time allocation of IRFS core topic areas, integration of contemporary informatics themes, and teacher qualification requirements.

By June 2024, 28 of the 36 countries had submitted responses. The data was analysed to identify commonalities in curriculum design and teacher education requirements. The results highlight the importance of informatics as an autonomous subject, the need to consider contemporary topics like AI and data science, and the necessity of specialised teacher education. The findings, along with graphical analyses, are detailed here in the full report, providing valuable insights for shaping informatics education policy and curriculum development across Europe.

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1. Introduction

In February 2022, the Informatics for All coalition (https://www.informaticsforall.org) released "The Informatics Reference Framework for School" (IRFS) (https://www.informaticsforall.org/the-informatics-reference-framework-for-school-release-february-2022/) outlining a reference framework for informatics education in school, with the goal to offer high-level guidance to informatics school curriculum designers [Inroads 2023]. The framework is based on a set of core concepts, which capture an essential view of informatics as a discipline in general education, and offer the basis for defining specific informatics curricula in each country, taking into account their traditions, languages, and cultures. The IRFS was published after a review by national informatics communities from 14 European countries and has been translated into several languages (https://www.informaticsforall.org/the-informatics-reference-framework-for-school-in-various-languages/).

The framework is intentionally concise, listing only five competency goals that all students should achieve at the end of their compulsory schooling. It also pays attention to the social aspects of digital technologies, a topic whose relevance is becoming more and more important. A condensed version of the overall aims and objectives was published in the ACM Magazine *Inroads* [Inroads 2023].

By the end of upper secondary education, students will have acquired the following five competencies:

1. Use digital tools in a conscious, responsible, confident, competent, and creative way.
2. Understand the principles and practices of informatics and their multifaceted applications.
3. Analyse, design, frame and solve problems "informatically."
4. Creatively develop computational models to investigate and communicate about phenomena and systems.
5. Identify and discuss ethical and social issues associated with computational systems and their use, potential benefits, and risks.

The framework is conceived as a high-level map of informatics and is expressed in terms of a high-level and robust set of 11 core topics areas, each characterised by a brief description. These descriptions identify the essential principles, practices and implications of informatics and information technology and include a substantial focus on the human/societal aspect and the responsibility and empowerment enabled by informatics. The core topic areas are presented concisely using generic and invariant terms (See Table 1), thus supporting temporal robustness and accommodation of local priorities when using the framework to design specific curricula.

Table 1. The 11 core topic areas and their descriptions

Core topic area	**Description**
Data and information	Understand how data are collected, organised, analysed and used to model, represent and visualise information about real-world artefacts and scenarios.
Algorithms	Evaluate, specify, develop, and understand algorithms.

Programming	Use programming languages to express oneself computationally by developing, testing and debugging digital artefacts; and understand what a programming language is.
Computing systems	Understand what a computing system is, how its constituent parts function together as a whole, and its limitations.
Networks and communication	Understand how networks enable computing systems to share information via interfaces and protocols, and how networks may introduce risks.
Human-computer interaction	Evaluate, specify, develop and understand interaction between people and computing artefacts.
Design and development	Plan and create computing artefacts taking into account stakeholders' viewpoints and critically evaluating alternatives and their outcomes.
Digital creativity	Explore and use digital tools to develop and maintain computing artefacts, also using a range of media.
Modeling and simulation	Evaluate, modify, design, develop, and understand models and simulations of natural and artificial phenomena and their evolution.
Privacy, safety and security	Understand risks when using digital technology, and how to protect individuals and systems.
Responsibility and empowerment	Critically and constructively analyse concrete computing artefacts as well as advanced and potentially controversial techniques and applications of informatics, particularly from an ethical and social perspective.

IRFS also lists 10 contemporary informatics themes, aiming to support the interpretation of the IRFS in the context of recent innovations in informatics:

1. Data science
2. Programming languages
3. Artificial intelligence
4. Machine learning
5. Computer graphics
6. Virtual reality
7. Augmented reality
8. Social networks
9. Automated decision making
10. Robotics

These 10 themes were discussed in the subsequent Informatics for All coalition's document "Building on the Informatics Reference Framework for School" (https://www.informaticsforall.org/building-on-the-informatics-reference-framework-for-school/), released in January 2023.

In November 2023, the Council of the European Union approved the "European Recommendation on Informatics Education at School" [Council-2023]. It recommends to all Member States to «*foster the provision of high quality education in informatics from the start of compulsory education*» and, among alia, recommends to *«ensure that teaching of informatics* […] *is provided by qualified teachers*».

On this basis, the I4All Steering Committee conducted a survey across Europe to investigate the extent to which it is possible, in the light of the diversity of educational systems, to identify common European guidelines for: (i) informatics education for students and (ii) the education of teachers for teaching informatics in school.

In the following we report on the outcome of this investigation.

2. Aims

For the purpose described above, instead of imposing a top-down set of recommendations, the decision was made to involve the European community of academic colleagues in informatics education and gather their input on requirements to build shared guidelines in a bottom-up manner. A sub-committee[1] of the Informatics for All coalition, was therefore established to carry out this work.

Since school education within the European Union remains the responsibility of the individual Member States, and there is a great diversity of languages, cultures, and school systems across Europe, the state of school education varies widely among Member States, particularly in informatics education. A recent survey on the status of informatics education in European schools [Eurydice 2022] shows clearly this variation. Given these differences, synthesizing a set of common requirements would have been almost impossible.

We therefore decided to reference what we termed "the ideal situation", where the curriculum for informatics is clearly identifiable e.g. informatics is being taught in school as an autonomous subject starting from primary school as is the case for mathematics. We recognized that in some countries this ideal may be far from the current reality. However, documenting the existing state of affairs seemed unproductive, as this had already been covered in the Eurydice Report cited in the previous paragraph. Additionally, focusing on the current state would have made it nearly impossible to agree on a set of shared requirements. Instead, by focusing on the ideal situation, we could gather national requirements based on what experts in informatics education in school might envision for their country if they had full authority to decide, regardless of the present circumstances.

It is well known that, while primary[2] and lower secondary[3] educational levels share a common structure across nearly all European countries, with variations in duration and organization, the upper secondary level is generally much more diverse. It typically offers three distinct tracks (general, technical, and vocational), each with numerous variations. Additionally, the duration of compulsory education (typically around 10 years) generally extends to the first half of the upper secondary education. However, countries manage the transition out of this compulsory education period in very different ways, making it difficult to obtain comparable data for this level. Therefore, we chose to focus solely on primary and lower secondary education.

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[1] Gerald Futschek (chair), Judith Gal Ezer, Enrico Nardelli, Mary Webb.

[2] Primary education denotes the level 1 (primary) of the 2011 ISCED International Standard Classification of Education https://uis.unesco.org/sites/default/files/documents/international-standard-classification-of-education-isced-2011-en.pdf

[3] Lower secondary education denotes the level 24 (lower secondary general) of the 2011 ISCED International Standard Classification of Education https://uis.unesco.org/sites/default/files/documents/international-standard-classification-of-education-isced-2011-en.pdf

3. Methods

We chose to contact a single point of reference for each country: either the person or committee responsible for school education issues within the national academic informatics organization (for countries where such organizations exist) or a relevant expert in the field. We asked them to engage the national community of interested colleagues and provide us, to the best of their ability, not their personal viewpoint on the matter but a nationally shared perspective. We decided not to conduct a mass survey aimed at reaching as many colleagues as possible across various countries, owing to the risk of under- or over-representing some countries.

We prepared an initial draft of the questionnaire and received feedback from both the I4All Steering Committee and a few colleagues working on this topic. The questionnaire was divided into two main sections, one for primary education and one for lower secondary education. Within each of them, the questions were designed to gather requirements for both the students' curriculum and teacher education.

Once the revised questionnaire was approved by the I4All Steering Committee, it was distributed to colleagues from 36 countries[4] at the end of March 2024, accompanied by an email explaining the overall purpose of the activity and providing instructions for completing it online.

The questionnaire (presented in full in Appendix 1) begins with a context section, allowing us to identify respondents and their respective countries.

Next, the section for primary school starts by asking about the entry age and duration of this school level. It then inquires how many hours per week, in the ideal situation, should be dedicated to informatics in primary education. Finally, it asks participants: (1) to provide the percentage allocation of those hours across all years for the 11 Core Topic Areas described in the IRFS, and (2) to rate the importance of including each of the 10 contemporary informatics themes in the students' curriculum.

The final part of the primary school section asks how many ECTS credits[5] of informatics education teachers should receive during their university degree programme to be qualified to teach informatics in primary school. It then repeats the two earlier questions (1) and (2), but this time in reference to the number of credits specified for teacher education.

The section for lower secondary school follows the same structure as the primary school section, with the same set of questions for each part.

The questionnaire concludes with a request for free-text comments.

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[4] Albania, Austria, Belgium (French speaking), Belgium (Flemish speaking), Bulgaria, Croatia, Czechia, Denmark, England, Estonia, Finland, France, Georgia, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Latvia, Lithuania, Netherlands, North Macedonia, Norway, Poland, Portugal, Romania, Scotland, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey, Ukraine.

[5] The European Credit Transfer and Accumulation System (ECTS) is described here https://en.wikipedia.org/wiki/European_Credit_Transfer_and_Accumulation_System

4. Results

By the end of June 2024, we closed the survey having received complete responses from 28 countries[6]. A full list of respondents can be found in Appendix 2.

4.1 Quantitative responses

A summary of the quantitative responses regarding core topic areas is presented in the following two tables (Tables 2 and 3), the first one organized by school level and the other one by the group under consideration (i.e., students or teachers).

In both of these tables the columns labeled "Value or Range" indicate the set of values that include at least 50% of respondents, the columns labeled "Num. Count." show how many countries represent at least 50% of all respondents, and the columns labeled "% Count." display the percentage of countries within the indicated Value or Range.

Table 2. Synthesis of quantitative responses for core topics areas organized by school level.

	PRIMARY						LOWER SECONDARY					
	Students			Teachers			Students			Teachers		
	Value or Range	Num. Count.	% Count.	Value or Range	Num. Count.	% Count.	Value or Range	Num. Count.	% Count.	Value or Range	Num. Count.	% Count.
GENERAL QUESTIONS												
Entry age	6	17	61%				10-12	23				
Duration	4-6	21	75%				3-4	23				
Weeks	33-38	17	61%				33-37	16				
Hours/week	1-2	22	79%				1-3	22				
Credits education				15-60	15	54%				30-120	15	54%
CORE TOPICS												
Data&Information	10-20	20	71%	10-20	21	75%	10-20	19	68%	10-15	21	75%
Algorithms	10-20	20	71%	10-20	21	75%	5-10	17	61%	10-15	15	54%
Programming	10-20	20	71%	10-20	22	79%	10-15	14	50%	10-15	15	54%
Comput.Systems	5-10	20	71%	5-10	23	82%	5-10	20	71%	10	14	50%
Netw. & Comm.	5-10	19	68%	5	15	54%	5	14	50%	5-10	25	89%
HCI	5-10	17	61%	5	15	54%	5	14	50%	5	15	54%
Design & Devel.	5-10	15	54%	5-10	19	68%	5-10	21	75%	5-10	22	79%
Digital Creativity	5-10	14	50%	5-10	16	57%	5-10	17	61%	5-10	16	57%
Model. & Simul.	5-10	15	54%	5-10	20	71%	5-10	20	71%	5-10	21	75%
Priv., Saf. & Sec.	5-10	22	79%	10	15	54%	5-10	21	75%	5-10	23	82%
Resp. & Empow.	5-10	21	75%	5-10	24	86%	5-10	21	75%	5-10	24	86%

[6] Albania, Austria, Belgium (French speaking), Bulgaria, Czechia, Denmark, England, Estonia, France, Georgia, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Latvia, Lithuania, Poland, Portugal, Romania, Scotland, Slovakia, Slovenia, Spain, Switzerland, Turkey.

Table 3. Synthesis of quantitative responses for core topics areas organized by group.

	STUDENTS						TEACHERS					
	Primary			Lower Secondary			Primary			Lower Secondary		
	Value or Range	Num. Count.	%. Count.	Value or Range	Num. Count.	%. Count.	Value or Range	Num. Count.	%. Count.	Value or Range	Num. Count.	%. Count.
GENERAL QUESTIONS												
Entry age	6	17	61%	10-12	23							
Duration	4-6	21	75%	3-4	23							
Weeks	33-38	17	61%	33-37	16							
Hours/week	1-2	22	79%	1-3	22							
Credits education							15-60	15	54%	30-120	15	54%
CORE TOPICS												
Data&Information	10-20	20	71%	10-20	19	68%	10-20	21	75%	10-15	21	75%
Algorithms	10-20	20	71%	5-10	17	61%	10-20	21	75%	10-15	15	54%
Programming	10-20	20	71%	10-15	14	50%	10-20	22	79%	10-15	15	54%
Comput.Systems	5-10	20	71%	5-10	20	71%	5-10	23	82%	10	14	50%
Netw. & Comm.	5-10	19	68%	5	14	50%	5	15	54%	5-10	25	89%
HCI	5-10	17	61%	5	14	50%	5	15	54%	5	15	54%
Design & Devel.	5-10	15	54%	5-10	21	75%	5-10	19	68%	5-10	22	79%
Digital Creativity	5-10	14	50%	5-10	17	61%	5-10	16	57%	5-10	16	57%
Model. & Simul.	5-10	15	54%	5-10	20	71%	5-10	20	71%	5-10	21	75%
Priv., Saf. & Sec.	5-10	22	79%	5-10	21	75%	10	15	54%	5-10	23	82%
Resp. & Empow.	5-10	21	75%	5-10	21	75%	5-10	24	86%	5-10	24	86%

A summary of the quantitative responses regarding contemporary themes is presented in the following table (Table 4). The columns labeled “Num. Countries” show how many countries express interest higher than average (i.e., level 4 or 5) and the columns labeled “% Countries” indicate which percentage of countries has expressed an interest higher than average (i.e., level 4 or 5). Highlights evidentiate, for each group and school level, the three themes ranked as more important.

Table 4. Synthesis of quantitative responses for the importance of contemporary topics.

	STUDENTS				TEACHERS			
	Primary		Lower Secondary		Primary		Lower Secondary	
	Num. Countries	% Countries	Num. Countries	% Countries	Num. Countries	% Countries	Num. Countries	% Countries
CONTEMPORARY TOPICS								
Data Science	17	61%	19	68%	21	75%	21	75%
Program. Languages	16	57%	21	75%	21	75%	22	79%
Artificial Intelligence	11	39%	16	57%	17	61%	17	61%
Machine Learning	10	36%	12	43%	12	43%	14	50%
Computer Graphics	8	29%	10	36%	9	32%	5	18%
Virtual Reality	7	25%	5	18%	8	29%	5	18%
Augmented Reality	5	18%	4	14%	7	25%	4	14%
Social Networks	12	43%	13	46%	8	29%	10	36%
Autom. Decis. Making	7	25%	7	25%	6	21%	8	29%
Robotics	17	61%	16	57%	15	54%	14	50%

Graphical representations of the responses to all the quantitative questions are available in Appendix 3. Here, we show just two examples of responses to selected important questions. In histograms representing questions that ask for values, the green bars denote the value or range that includes at least 50% of respondents, while the orange bars highlight some relevant outliers. In histograms addressing questions about the importance (1=lowest, 5=highest) the green bars highlight answers that reflect a higher-than-average importance. The two example graphs below (Figures 1 and 2) relate to primary schools, both from the students' curriculum section.

Figure 1 shows the number of responses for various percentages to the question regarding the percentage of the overall teaching hours for informatics that should be allocated to "Algorithms" in the students' curriculum in primary school.

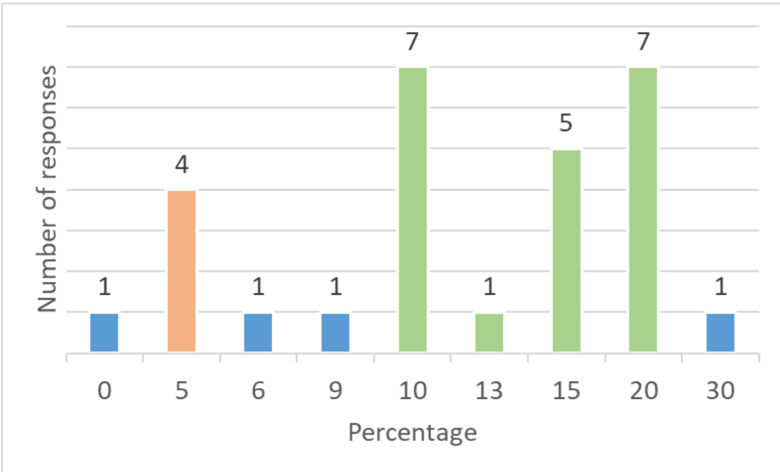


Figure 1. Number of responses for various percentages of the overall teaching hours for informatics that should be allocated to "Algorithms" in the students' curriculum in primary school

Figure 2 shows the number of responses for various levels of importance to the question regarding the importance of Artificial Intelligence in the students' curriculum in primary school.

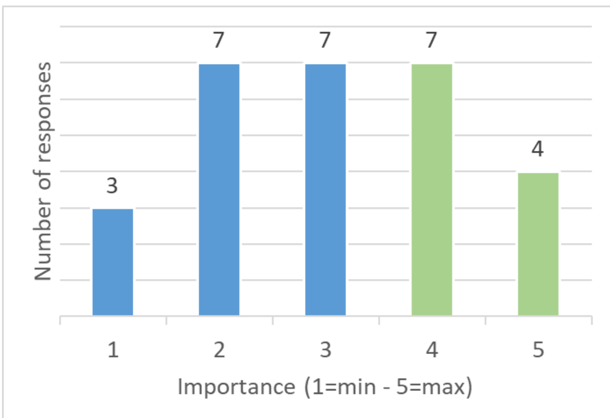


Figure 2. Number of responses for the various levels of importance to the question regarding the importance of Artificial Intelligence" in the students' curriculum in primary school

4.2 Qualitative responses

We now provide a synthesis of the major recurring themes which emerged from responses to the free-text questions of our survey.

We note that many countries highlighted the need to consider ethics both for the students' curriculum and for teachers' education. Some countries discussed the importance of clarifying relationships between informatics and the more operational digital skills. The importance of Pedagogical Content Knowledge (PCK) for informatics, and educating teachers in methodologies of teaching informatics and assessing performances was stressed by many countries. Some countries stressed the importance for students of doing project-oriented and multi- and inter-disciplinary work using a variety of tools and systems, including physical ones. Some respondents mentioned the importance for informatics teachers of staying abreast of the latest research and innovations in the rapidly evolving field of informatics.

5. Findings and Discussion

The survey responses reveal significant variation across countries, as evidenced by the graphs in the previous section and the complete dataset in Appendix 3. Countries place varying emphasis on different aspects of informatics education, reflecting their local priorities and educational contexts. Despite these differences, several common patterns emerge.

Concerning the weekly time allocation for informatics in students' curriculum a broad consensus emerged for 1-2 hours in primary school and 1-3 hours in lower secondary school.

Regarding curriculum content, there is broad consensus that three core topic areas—"Data and information", "Algorithms", and "Programming"—should receive 10-20% of instructional time each, whilst the remaining eight areas should receive 5-10% each. This aligns with the findings of the Eurydice report "Informatics education at school in Europe".

For the contemporary themes, the consensus regarding priorities, in order of importance, is:

- Primary education: data science, robotics, programming languages
- Lower secondary education: programming languages, data science, artificial intelligence and robotics

Concerning teachers' pre-service education, a broad consensus emerged for 15-60 ECTS credits for primary school teachers and 30-120 ECTS credits for lower secondary school teachers.

These credits encompass Content Knowledge and Pedagogical Content Knowledge, excluding general pedagogy and practical work. The three core topics—"Data and information", "Algorithms", and "Programming"—should comprise approximately half of the teacher education curriculum credits, with the remaining eight areas sharing the other half approximately equally. These three core topics were also recommended to comprise the larger share (50%) of teacher education curriculum credits.

The consensus emerged regarding the priority of contemporary themes for teacher education is, in order of importance:

- Primary: data science, programming languages, artificial intelligence
- Lower secondary: programming languages, data science, artificial intelligence

A broad consensus across countries stressed the importance of educating teachers in PCK for informatics as well as effective pedagogical approaches for enabling students to develop their understanding and skills.

The Importance of ethics was emphasised by respondents even though it is already present in the 11th Core Topic Area, "Responsibility and empowerment", which is described as: "Critically and constructively analyse concrete computing artefacts as well as advanced and potentially controversial techniques and applications of informatics, particularly from an ethical and social perspective". This finding might indicate that ethics, particularly with the arrival and expansion of artificial intelligence tools, is felt to be of crucial importance in school informatics education. Furthermore, the emphasis on ethics might indicate that national systems for teachers' education do not provide them adequate preparation in this area.

Regarding the relationship between informatics and digital skills, which some respondents felt needed clarification, in the IRFS, digital skills is regarded as operational knowledge and thus part of the process of teaching informatics (in some sense like learning how to write numbers is part of the process of learning mathematics). Indeed the first of the overall aims and objectives of the IRFS is "Use digital tools in a conscious, responsible, confident, competent, and creative way."

While the IRFS focused on content, teaching methods and pedagogical approaches were mentioned as crucial considerations when implementing informatics education. However, many respondents stressed the importance of PCK and pedagogical approaches. This finding indicates that in moving forward, greater emphasis should be placed on pedagogical approaches to informatics teaching and learning. In-service teachers require ongoing professional development to keep pace with the rapidly evolving technological landscape of informatics and the resulting changes to PCK.

6. Conclusion and Recommendations

The IRFS, released by the Informatics for All coalition in February 2022, served as the foundation for this study. The findings of the survey reported here indicate the effectiveness of the IRFS in providing a broadly shared perspective on informatics, structured around 11 fundamental core topic areas. The IRFS also highlights key principles, practices, and impacts of informatics and information technology, while also emphasising the human and societal dimensions, as well as the responsibility and empowerment that informatics enables. Its robust articulation ensures both long-term relevance and adaptability to local educational priorities. Meanwhile, the companion document "Building on the Informatics Reference Framework for School" offers guidance for developing curricula that incorporate recent innovations in informatics, helping to align them with learners' interests.

In this study we asked respondents to reference "the ideal situation", where the curriculum for informatics is clearly identifiable, e.g., informatics is being taught in school as an autonomous subject starting from primary school. Therefore for some countries implementing these goals immediately may be very challenging. Nevertheless these findings indicate the desired direction of development and for countries they represent a reasonably short term aim.

The findings show, as expected, significant variation across countries in terms of the varying emphasis on different aspects of informatics education reflecting their local priorities and contexts. Nevertheless, important common patterns emerged, including a broad consensus on 1-2 hours of informatics in primary schools and 1-3 hours in lower secondary schools per week. There was also a broad consensus on the importance of the core topics of data and information, algorithms and programming which should receive 10-20% of instructional time each whilst the remaining 8 topics should receive 5-10% each. For contemporary themes, data science, programming languages and artificial intelligence/robotics emerged as top priorities. Furthermore, there is a broad consensus regarding the importance of educating teachers in PCK for informatics as well as effective pedagogical approaches for enabling students to develop their understanding and skills. The consensus is for 15-60 ECTS credits for primary school teachers pre-service education and 30-120 ECTS credits for lower secondary school teachers.

We hope that the results of our survey will assist policy makers and school education leaders in designing their plans,curricula and teacher education priorities. Beyond pre-service training, continuous professional development is crucial for informatics teachers, as the field evolves rapidly. The survey highlights the need for educators to stay updated with the latest research and innovations in informatics and to continue to develop their PCK and pedagogical approaches.

We also recommend, as suggested by one respondent, fostering a culture of innovation within the teaching community to inspire educators to experiment with new teaching methodologies, tools, and technologies, thereby enhancing the learning experience for students. There remains a need for more research to build a robust body of knowledge about students' learning trajectories and associated pedagogical approaches in more traditional informatics skill areas such as programming. Incorporating more recent innovations, such as those in AI and data science, present further challenges for research and development of effective pedagogical strategies.

As we release this report the European Commission, as a direct follow-up of the Council Recommendation, has appointed an Expert Group focusing on the development of guidelines on high-quality informatics[7]. Its tasks are to assist the European Commission in preparing legislative proposals and policy initiatives regarding: (1) clear and shared vision of high-quality informatics education for both learners and teachers; (2) common challenges in informatics education, such as assessment, teacher training, recruitment, and content quality; (3) pedagogical support to teachers and educators.

With the European Union's push and recommendations, countries that have lagged behind in introducing informatics education are expected to begin designing and implementing national plans. These plans will integrate informatics into school curricula at all levels and ensure the necessary preparation of teachers.

Teachers are the cornerstone for the implementation of every study program, however without basic research it will be difficult to implement the best of study programs. We recommend researchers to build upon these findings to strengthen the body of knowledge, not neglecting the PCK, which still lags behind that of other subjects especially when referring to elementary and middle school.

Acknowledgements

We acknowledge the contribution of the many colleagues who provided data for their country by answering our survey. Their names are listed in Appendix 2. We greatly thank them and clarify that the responsibility for what is written in this report is ours.

References

DEAP, 2020. European Commission. *Digital Education Action Plan 2021-2027: Resetting education and training for the digital age*. September 2020. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52020DC0624

Inroads, 2023. Michael E. Caspersen, Judith Gal-Ezer, Andrew McGettrick, and Enrico Nardelli. *Informatics Education for School: A European Initiative*. ACM Inroads, 14(1), pp. 49-53, February 2023.

Council, 2023. Council of the European Union. *Council recommendation on improving the provision of digital skills and competences in education and training*. November 2023. https://eur-lex.europa.eu/eli/C/2024/1030/oj

Eurydice, 2022. *Informatics Education at School in Europe*. September 2022. https://eurydice.eacea.ec.europa.eu/publications/informatics-education-school-europe

[7] https://ec.europa.eu/transparency/expert-groups-register/screen/expert-groups/consult?lang=en&groupID=3943

Appendices

Appendix 1 – Text of the survey

We present here the full text of the survey, but for some contextual information regarding the respondent.

Primary School

In this section we ask you some questions regarding primary education in your country.

Note that by "primary education" we mean the level 1 (primary) of the 2011 ISCED International Standard Classification of Education (please see https://uis.unesco.org/sites/default/files/documents/international-standard-classification-of-education-isced-2011-en.pdf), which typically begins at age 5-7.

PS-1. Please specify the typical (not exceptional) age of entry in primary education in your country:

PS-2. Please specify the typical years of duration of primary education in your country:

PS-3. How many actual weeks of teaching are there in total in a school year in primary education in your country?

PS-4. How many hours a week should ideally be dedicated to informatics in primary education in your country?

PS-5. With reference to the 11 Core Topic Areas described in the Informatics Reference Framework for School (please see https://www.informaticsforall.org/the-informatics-reference-framework-for-school-in-various-languages/) please list for each of them which percentage should ideally be allocated to it in teaching informatics, across all the years, in primary education in your country. (NOTE: There is no need to insert the percentage sign (%). The system will check that the total adds up to 100).

Data and information
Algorithms
Programming
Computing systems
Networks and communication
Human-computer interaction
Design and development
Digital creativity
Modeling and simulation
Privacy, safety and security
Responsibility and empowerment

PS-6. With reference to the contemporary themes described in detail in https://www.informaticsforall.org/wp-content/uploads/2023/08/Building-on-the-Informatics-Reference-Framework-for-School-release-January-2023.pdf please indicate how important is their presence in an ideal curriculum for **primary education** in your country. Please choose the appropriate response for each item (NOTE: 1 = lowest importance - 5 = highest importance)

Data science
Programming languages
Artificial intelligence
Machine learning
Computer graphics
Virtual reality
Augmented reality
Social networks
Automated decision making
Robotics

PS-7. If you feel there are other topics whose presence is important in an ideal curriculum for primary education in your country, beyond those listed above and described in detail in https://www.informaticsforall.org/wp-content/uploads/2023/08/Building-on-the-Informatics-Reference-Framework-for-School-release-January-2023.pdf, please provide your viewpoint:

Primary School Teachers Education

In this section we ask you some questions about education requirements for teachers of Informatics in primary school in your country.

PS-T-1. How many credits of education in informatics should **teachers** receive in total, during their university degree programme, to be able to teach informatics in **primary school** in an ideal situation in your country? Please make reference to the European Credit Transfer and Accumulation System (ECTS - described here https://en.wikipedia.org/wiki/European_Credit_Transfer_and_Accumulation_System), where one full time academic year corresponds to 60 ECTS credits that are normally equivalent to 1500–1800 hours of total workload, irrespective of standard or qualification type:

PS-T-2. With reference to the 11 Core Topic Areas described in the Informatics Reference Framework for School (please see https://www.informaticsforall.org/the-informatics-reference-framework-for-school-in-various-languages/) please list for each of them which percentage should ideally be allocated to it, across all the years, in **educating teachers** for teaching informatics in **primary school** in your country. (NOTE: There is no need to insert the percentage sign (%). The system will check that the total adds up to 100).

Data and information
Algorithms
Programming
Computing systems
Networks and communication
Human-computer interaction
Design and development
Digital creativity
Modeling and simulation
Privacy, safety and security
Responsibility and empowerment

PS-T-3. With reference to the contemporary themes described in detail in https://www.informaticsforall.org/wp-content/uploads/2023/08/Building-on-the-Informatics-Reference-Framework-for-School-release-January-2023.pdf please indicate how important is their presence in **educating teachers** for teaching informatics in an ideal situation for **primary school** in your country. Please choose the appropriate response for each item (NOTE: 1 = lowest importance - 5 = highest importance).

Data science
Programming languages
Artificial intelligence
Machine learning
Computer graphics
Virtual reality
Augmented reality
Social networks
Automated decision making
Robotics

PS-T-4. If you feel there are other topics whose presence is important in **educating teachers** for teaching informatics in an ideal situation for **primary education** in your country, beyond those listed above and described in detail in https://www.informaticsforall.org/wp-content/uploads/2023/08/Building-on-the-Informatics-Reference-Framework-for-School-release-January-2023.pdf, please provide your viewpoint:

Lower Secondary School

In this section we ask you some questions regarding lower secondary education in your country.

Note that by "lower secondary education" we mean the level 24 (lower secondary general) of the 2011 ISCED International Standard Classification of Education (please see https://uis.unesco.org/sites/default/files/documents/international-standard-classification-of-education-isced-2011-en.pdf)

LS-1. Please specify the typical (not exceptional) age of entry in **lower secondary education** in your country:

LS-2. Please specify the typical years of duration of **lower secondary education** in your country:

LS-3. How many actual weeks of teaching are there in total in a school year in **lower secondary education** in your country?

LS-4. How many hours a week should ideally be dedicated to informatics in **lower secondary education** in your country?

LS-5. With reference to the 11 Core Topic Areas described in the Informatics Reference Framework for School (please see https://www.informaticsforall.org/the-informatics-reference-framework-for-school-in-various-languages/) please list for each of them which percentage should ideally be allocated to it in teaching informatics, across all the years, in

lower secondary education in your country. (NOTE: There is no need to insert the percentage sign (%). The system will check that the total adds up to 100).

Data and information
Algorithms
Programming
Computing systems
Networks and communication
Human-computer interaction
Design and development
Digital creativity
Modeling and simulation
Privacy, safety and security
Responsibility and empowerment

LS-6. With reference to the contemporary themes described in detail in https://www.informaticsforall.org/wp-content/uploads/2023/08/Building-on-the-Informatics-Reference-Framework-for-School-release-January-2023.pdf please indicate how important is their presence in an ideal curriculum for **lower secondary education** in your country. Please choose the appropriate response for each item (NOTE: 1 = lowest importance - 5 = highest importance).

Data science
Programming languages
Artificial intelligence
Machine learning
Computer graphics
Virtual reality
Augmented reality
Social networks
Automated decision making
Robotics

LS-7. If you feel there are other topics whose presence is important in an ideal curriculum for **lower secondary education** in your country, beyond those listed above and described in detail in https://www.informaticsforall.org/wp-content/uploads/2023/08/Building-on-the-Informatics-Reference-Framework-for-School-release-January-2023.pdf, please provide your viewpoint.

Lower Secondary School Teachers Education

In this section we ask you some questions about education requirements for teachers of Informatics in lower secondary school in your country.

LS-T-1. How many credits of education in informatics should **teachers** receive in total, during their university degree programme, to be able to teach informatics in **lower secondary school** in an ideal situation in your country? Please make reference to the European Credit Transfer and Accumulation System (ECTS - described here https://en.wikipedia.org/wiki/European_Credit_Transfer_and_Accumulation_System), where one full time academic year corresponds to 60 ECTS credits that are normally equivalent to 1500–1800 hours of total workload, irrespective of standard or qualification type.

LS-T-2. With reference to the 11 Core Topic Areas described in the Informatics Reference Framework for School (please see https://www.informaticsforall.org/the-informatics-reference-framework-for-school-in-various-languages/) please list for each of them which percentage should ideally be allocated to it, across all the years, in **educating teachers** for teaching informatics in **lower secondary school** in your country. (NOTE: There is no need to insert the percentage sign (%). The system will check that the total adds up to 100).

Data and information
Algorithms
Programming
Computing systems
Networks and communication
Human-computer interaction
Design and development
Digital creativity
Modeling and simulation
Privacy, safety and security
Responsibility and empowerment

LS-T-3. With reference to the contemporary themes described in detail in https://www.informaticsforall.org/wp-content/uploads/2023/08/Building-on-the-Informatics-Reference-Framework-for-School-release-January-2023.pdf please indicate how important is their presence in **educating teachers** for teaching informatics in an ideal situation for **lower secondary school** in your country.

Please choose the appropriate response for each item (NOTE: 1 = lowest importance - 5 = highest importance).

Data science
Programming languages
Artificial intelligence
Machine learning
Computer graphics
Virtual reality
Augmented reality
Social networks
Automated decision making
Robotics

LS-T-4. If you feel there are other topics whose presence is important in **educating teachers** for teaching informatics in an ideal situation for **lower secondary education** in your country, beyond those listed above and described in detail in https://www.informaticsforall.org/wp-content/uploads/2023/08/Building-on-the-Informatics-Reference-Framework-for-School-release-January-2023.pdf , please provide your viewpoint:

LS-T-5. Please provide any comments you feel relevant for our goal of formulating European guidelines for informatics teacher education

:

Appendix 2 – Contributors

In the table below we list names of people who have contributed to this research by providing information for their country.

Country	Name	Country	Name
Albania	Alfons Harizaj	Ireland	Keith Quille
Austria	Andreas Bollin	Israel	Ofra Brandes
Belgium	Kim Mens	Italy	Enrico Nardelli
Bulgaria	Galina Momcheva	Latvia	Viesturs Vēzis
Czechia	Tomáš Průcha	Lithuania	Valentina Dagiene
Denmark	Ole Sejer Iversen	Poland	Maciej Sysło
England	Niel McLean	Portugal	Fernanda Ledesma
Estonia	Mart Laanpere	Romania	Camelia Chira
France	Jean-Marc Vincent	Scotland	Charlie Love
Georgia	Magda Tsintsadze	Slovakia	Branislav Rovan
Germany	Daniel Losch	Slovenia	Andrej Brodnik
Greece	Zacharoula Smyrnaiou	Spain	Angel Velazquez
Hungary	Agnes Erdösne Nemeth	Switzerland	Gabriel Parriaux
Iceland	Kari Halldorsson	Turkey	Yasemin Gülbahar

Appendix 3 – Responses to the survey

This appendix provides all the graphs showing responses to the survey discussed in the paper. Please refer to the Appendix 1 for a detailed description of each question.

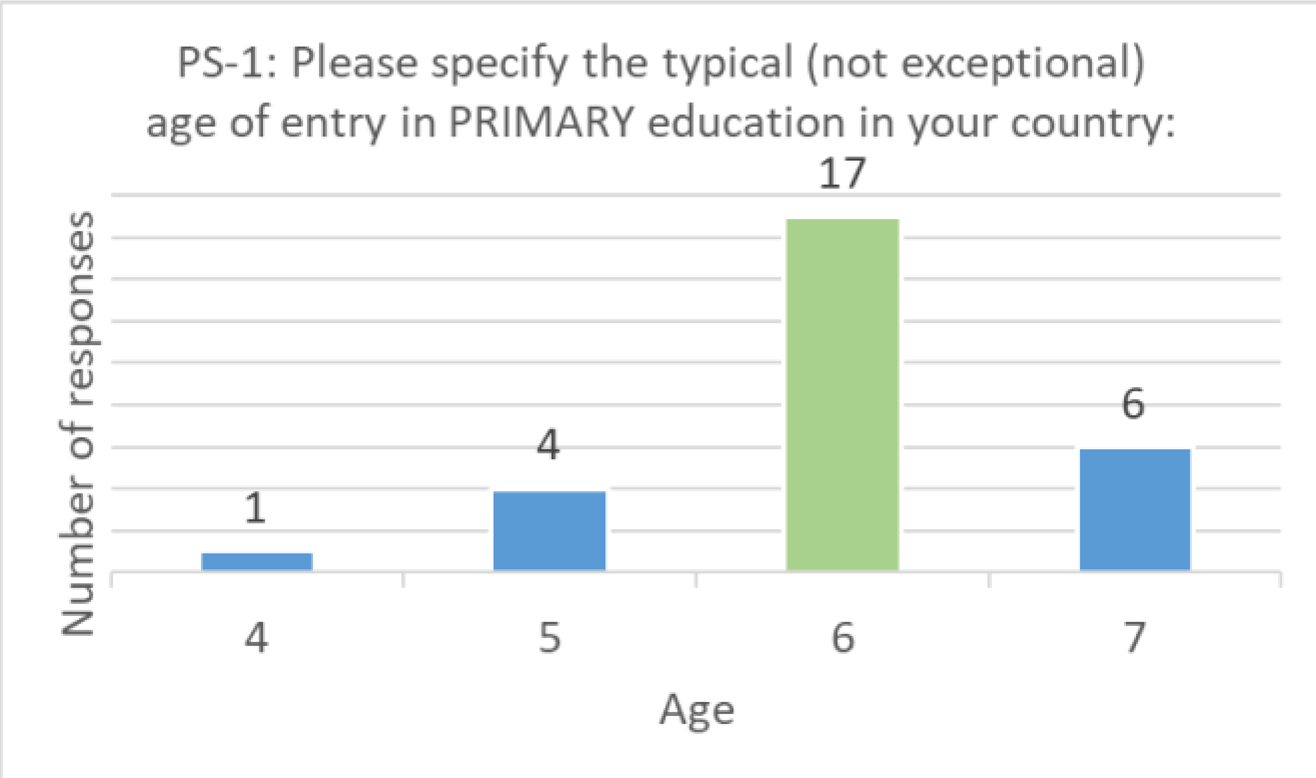
In histograms representing questions that ask for values, the green bars denote the value or range that includes at least 50% of respondents, while the orange bars highlight some relevant outliers. In histograms addressing questions about the importance (1=lowest, 5=highest) the green bars highlight answers that reflect a higher-than-average importance.

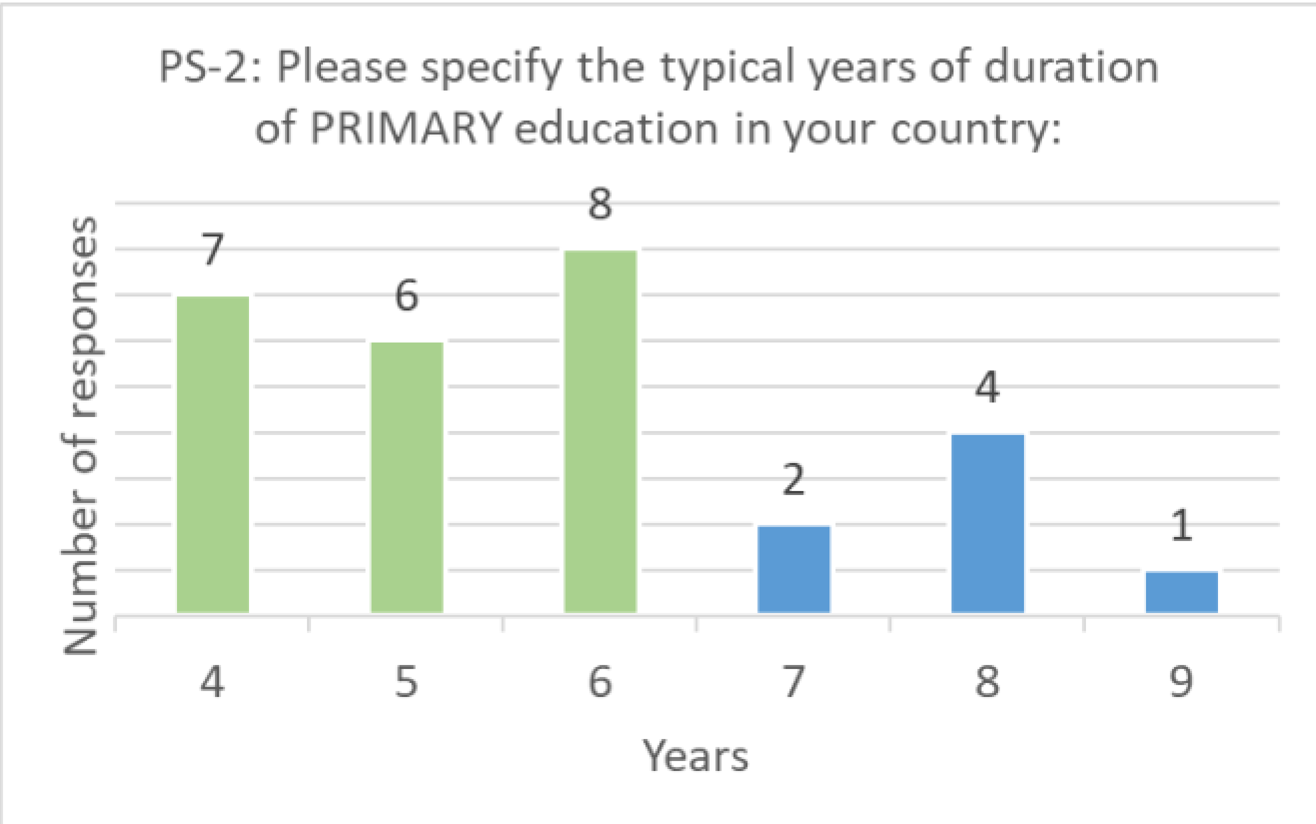
The structure of this Appendix is as it follows:

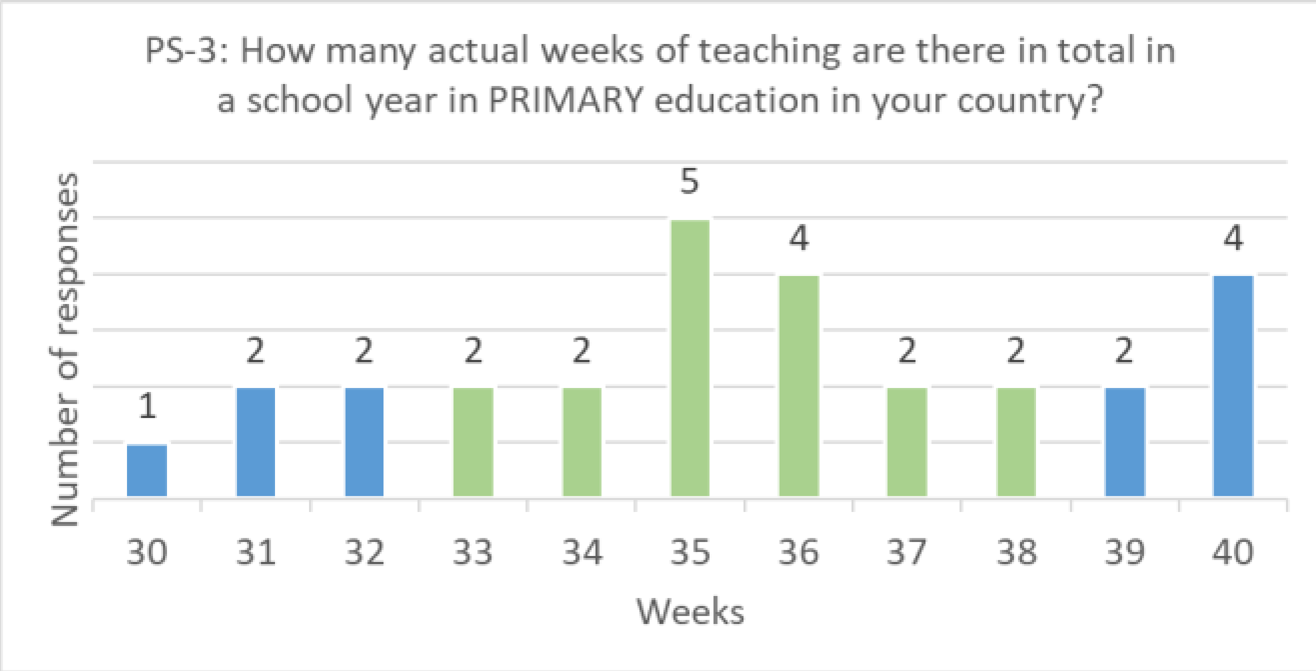
Primary School
- *Student curriculum*
  - General questions
  - Core topic areas
  - Contemporary topics
- *Teacher education*
  - General question
  - Core topic areas
  - Contemporary topics

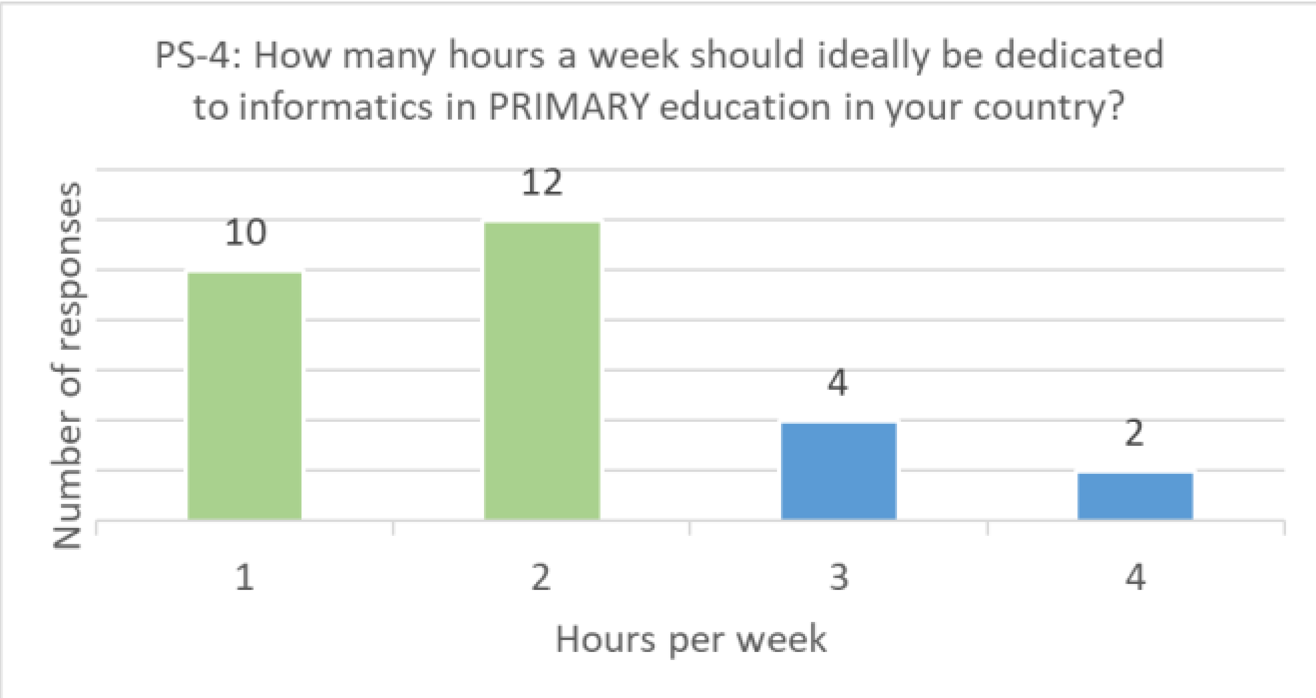
Lower secondary School
- *Student curriculum*
  - General questions
  - Core topic areas
  - Contemporary topics
- *Teacher education*
  - General question
  - Core topic areas
  - Contemporary topics

Primary School, general questions



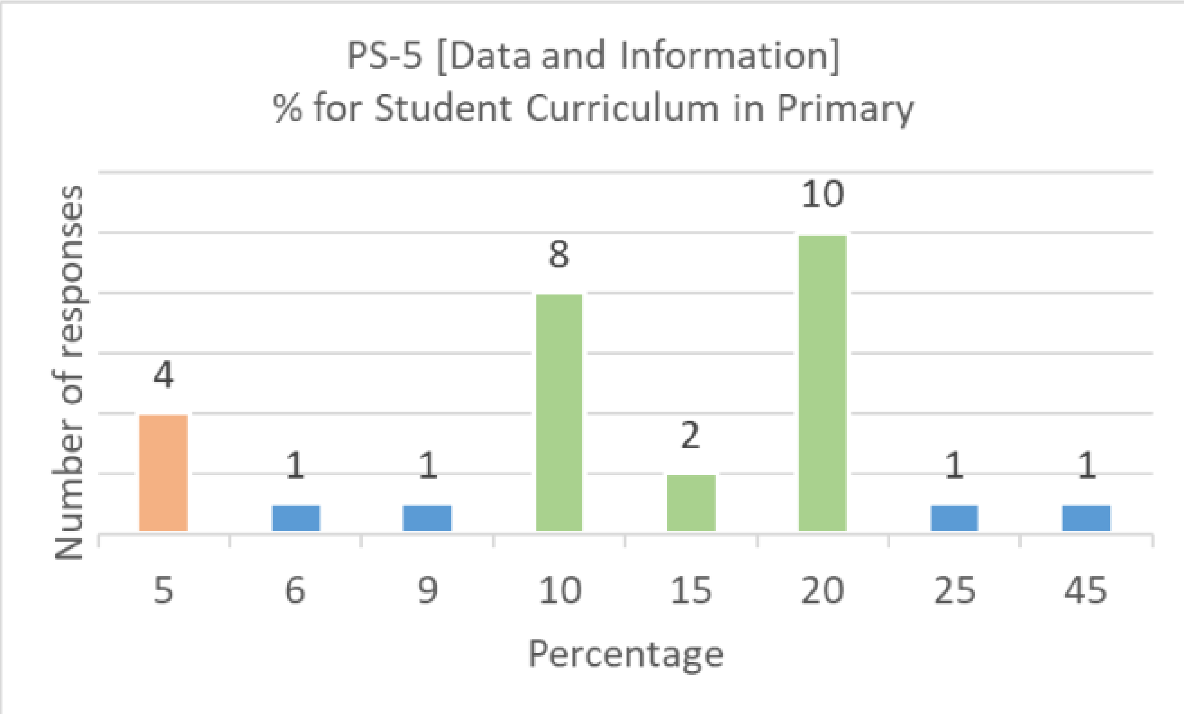


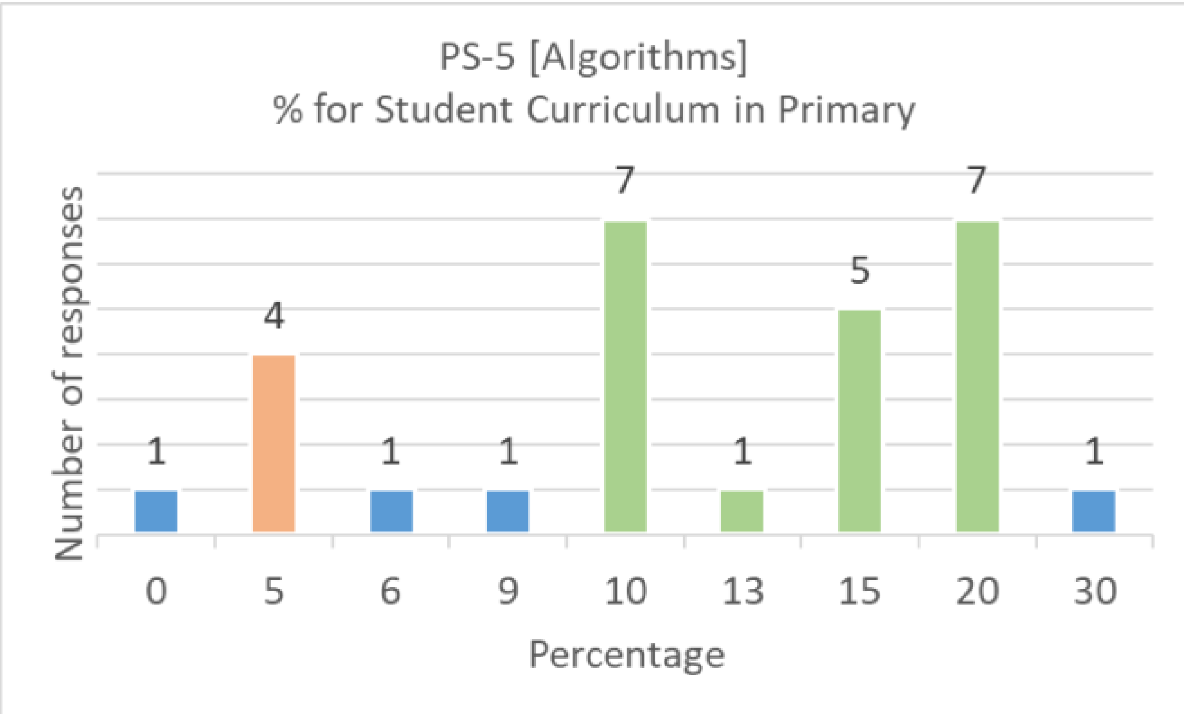

PS-3: How many actual weeks of teaching are there in total in a school year in PRIMARY education in your country?
Number of responses
Weeks
30
31
32
33
34
35
36
37
38
39
40
1
2
2
2
2
5
4
2
2
2
4

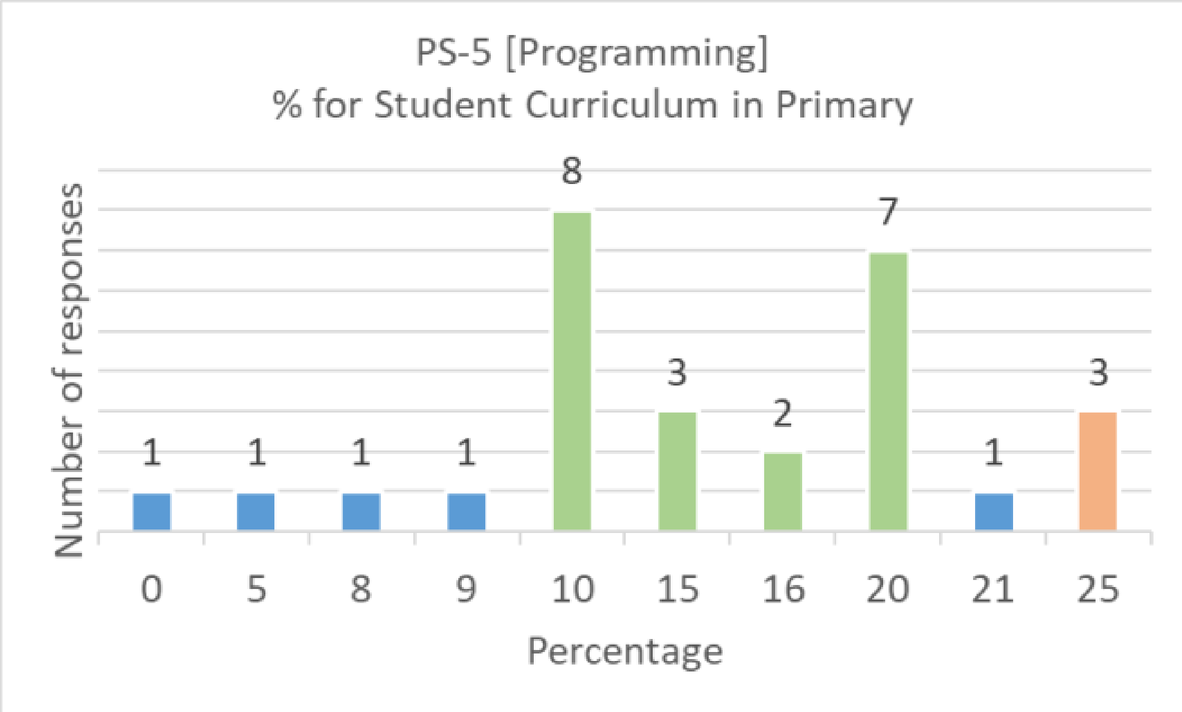

PS-4: How many hours a week should ideally be dedicated to informatics in PRIMARY education in your country?
Number of responses
Hours per week
1
2
3
4
10
12
4
2

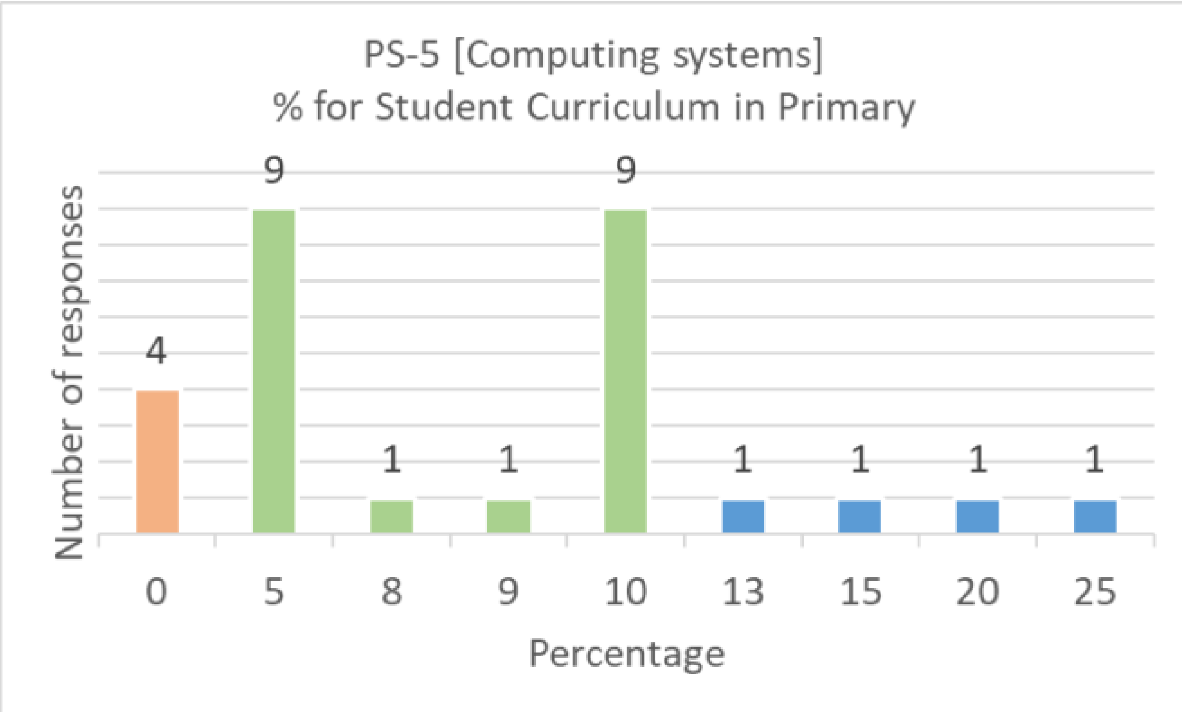
Primary School, student curriculum, core topic areas

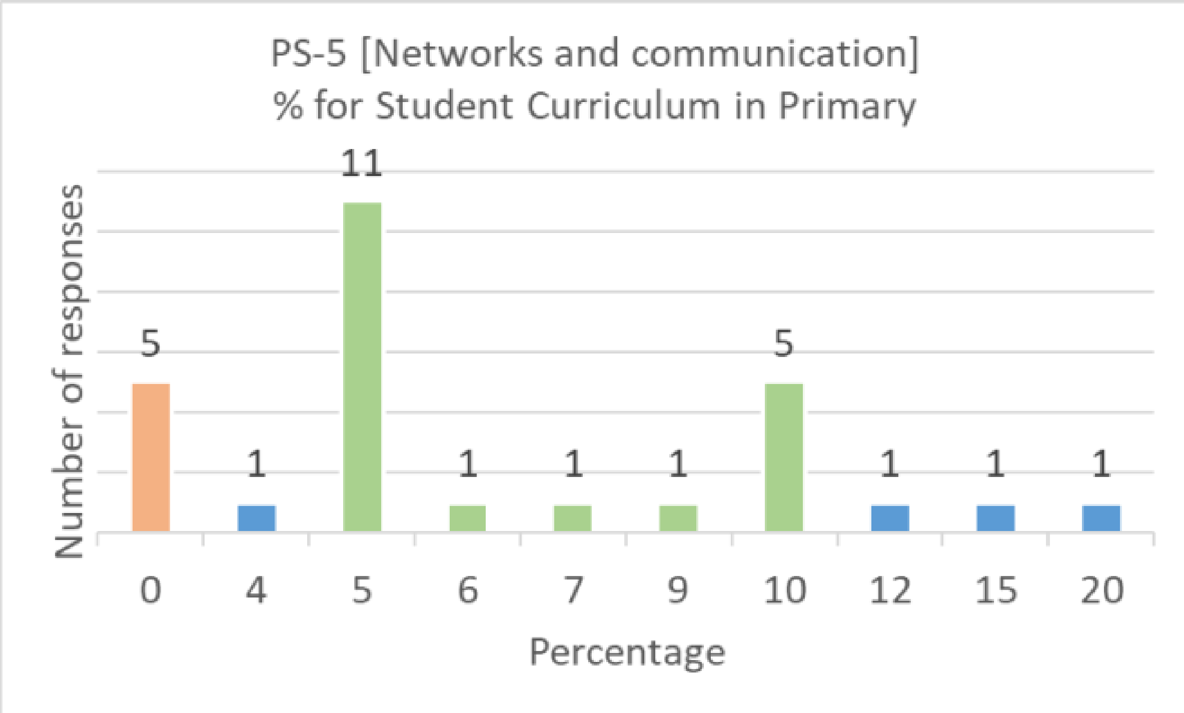
Percentage of informatics curriculum time ideally allocated to each of the [11 Core Topic Areas] described in the Informatics Reference Framework for School.

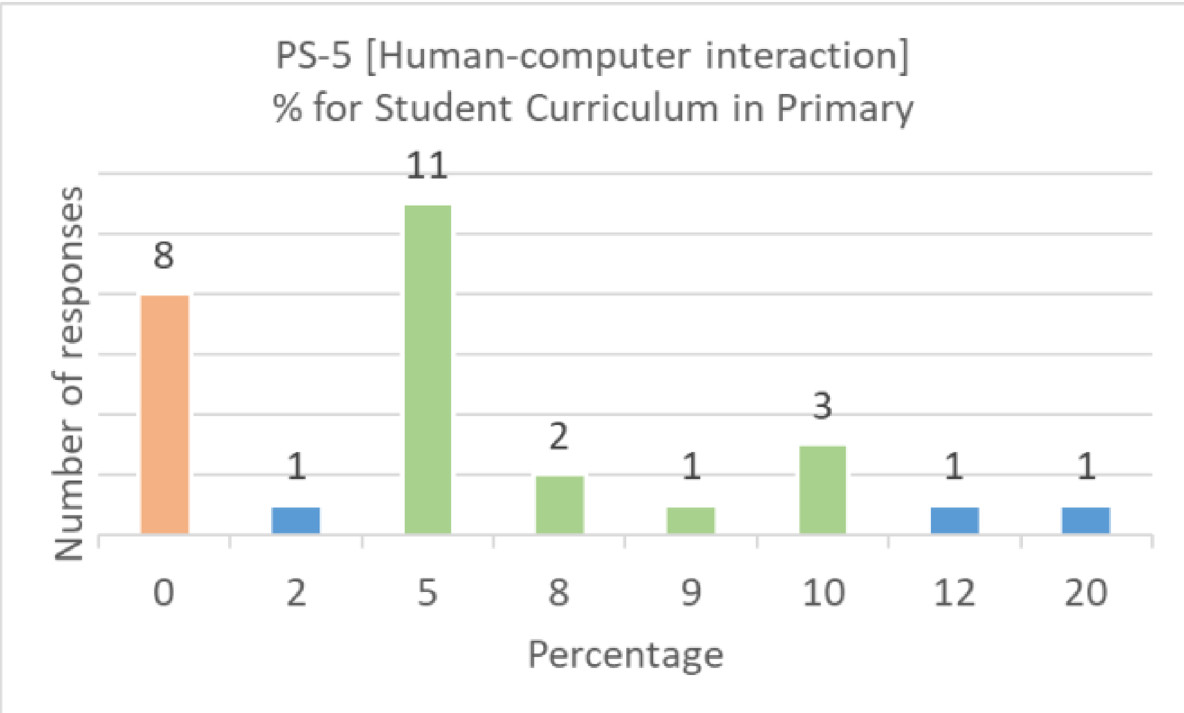


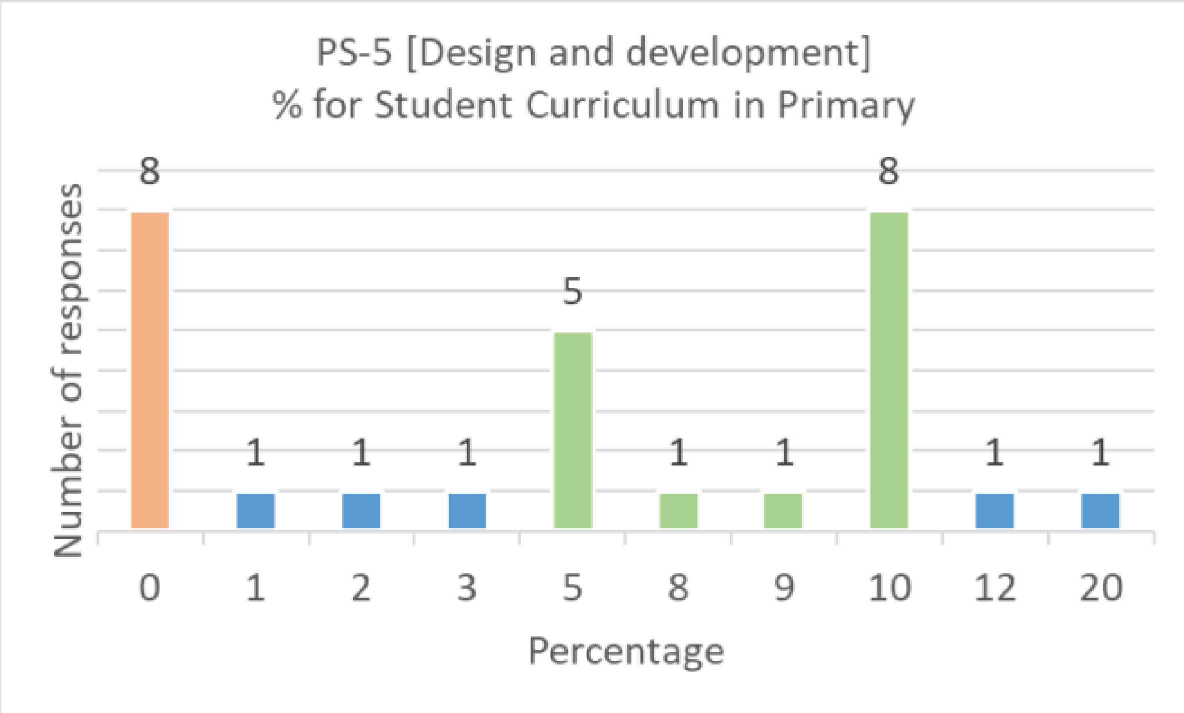


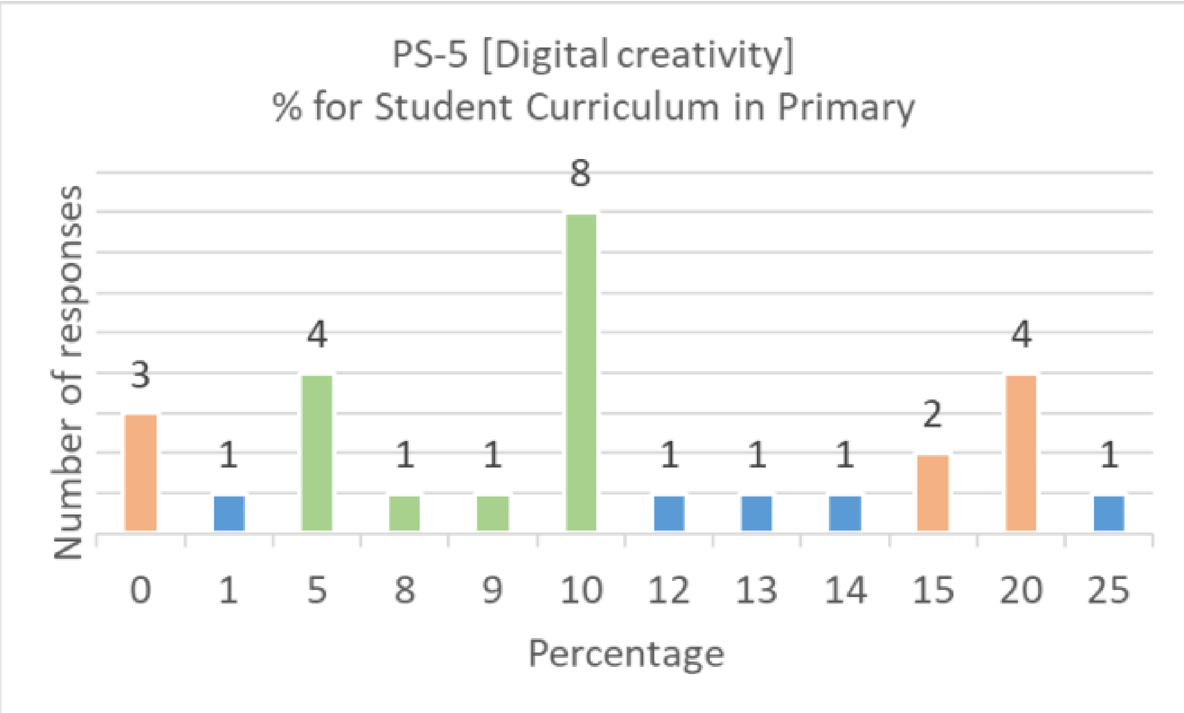

PS-5 [Programming]
% for Student Curriculum in Primary
Number of responses
1
1
1
1
8
3
2
7
1
3
0
5
8
9
10
15
16
20
21
25
Percentage

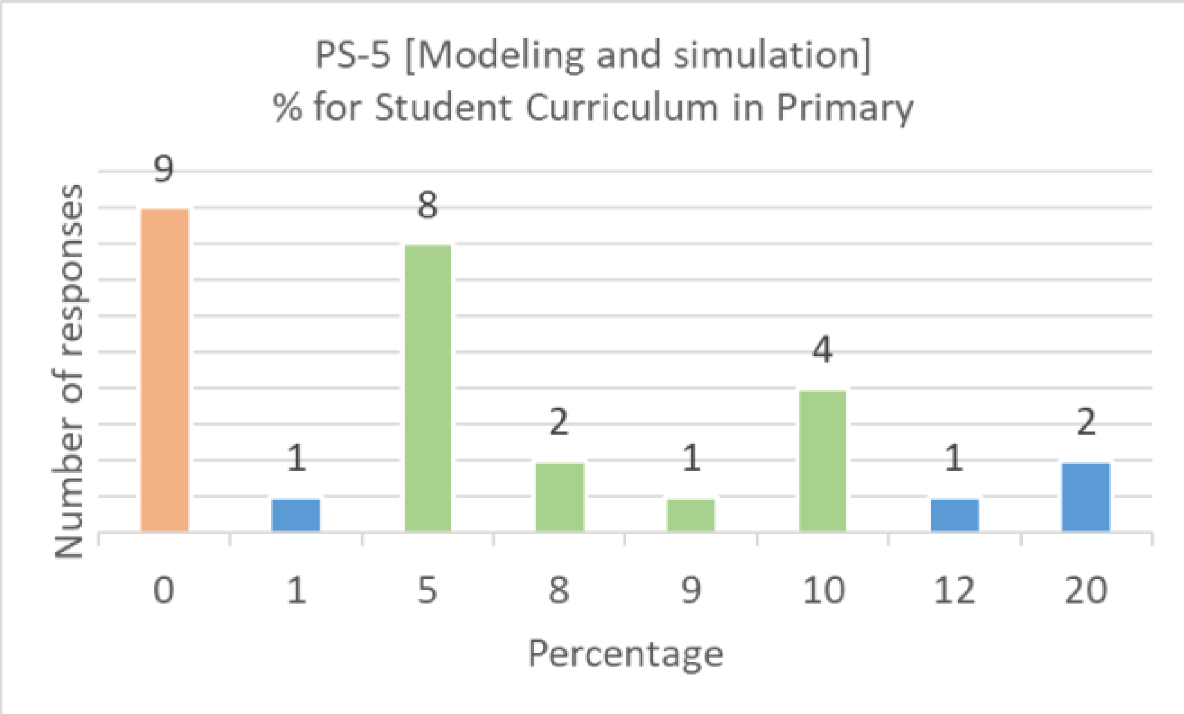

PS-5 [Computing systems]
% for Student Curriculum in Primary
Number of responses
4
9
1
1
9
1
1
1
1
0
5
8
9
10
13
15
20
25
Percentage

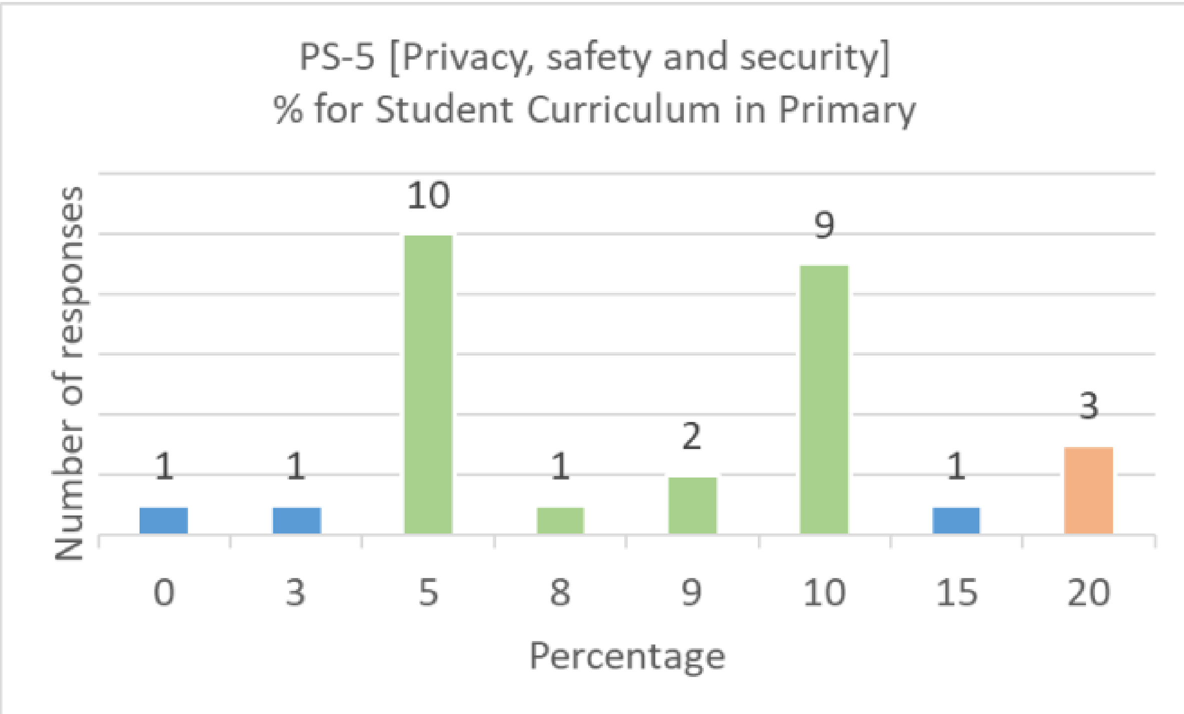

PS-5 [Networks and communication]
% for Student Curriculum in Primary
Number of responses
5
1
11
1
1
1
5
1
1
1
0
4
5
6
7
9
10
12
15
20
Percentage

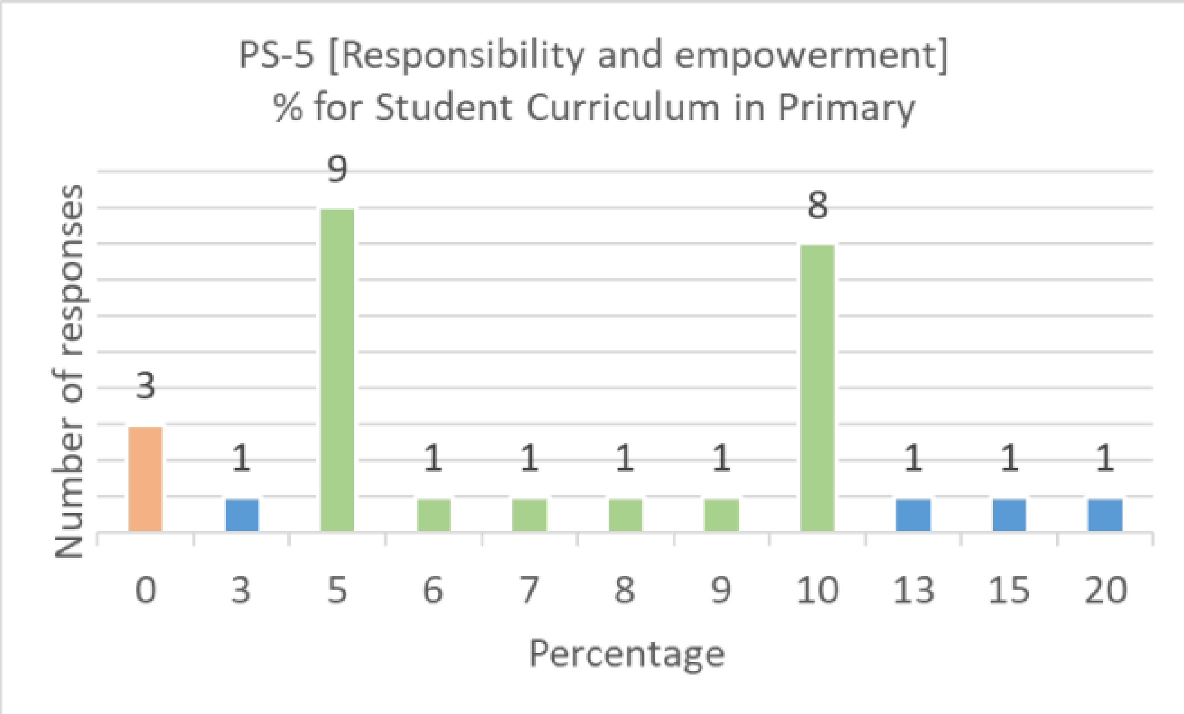

PS-5 [Human-computer interaction]
% for Student Curriculum in Primary
Number of responses
8
1
11
2
1
3
1
1
0
2
5
8
9
10
12
20
Percentage


PS-5 [Design and development]
% for Student Curriculum in Primary
Number of responses
8
1
1
1
5
1
1
8
1
1
0
1
2
3
5
8
9
10
12
20
Percentage


PS-5 [Digital creativity]
% for Student Curriculum in Primary
Number of responses
3
1
4
1
1
8
1
1
1
2
4
1
0
1
5
8
9
10
12
13
14
15
20
25
Percentage

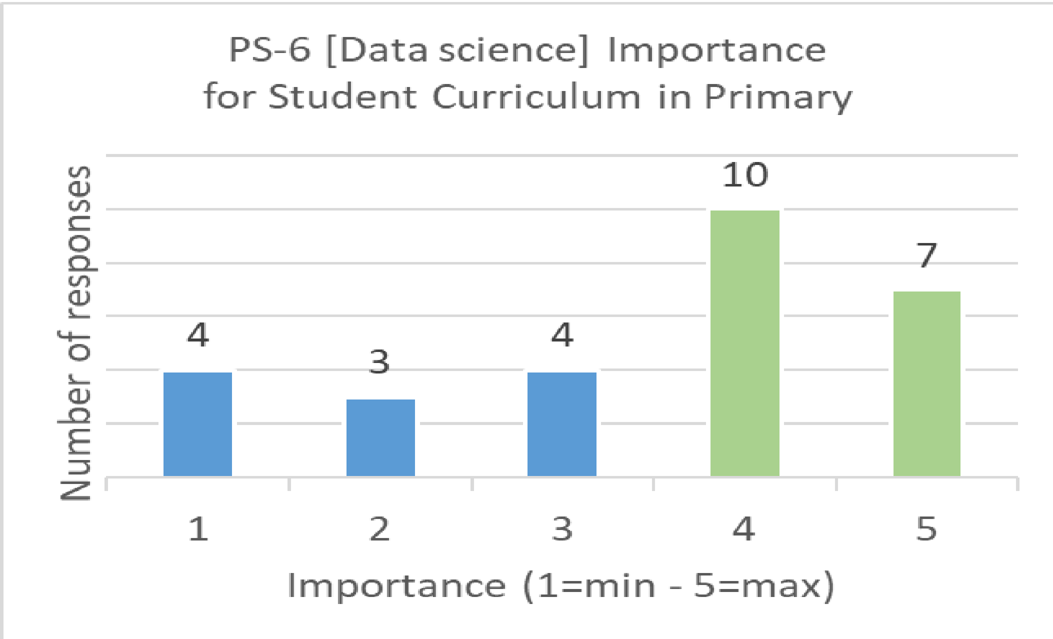

PS-5 [Modeling and simulation]
% for Student Curriculum in Primary
Number of responses
9
1
8
2
1
4
1
2
0
1
5
8
9
10
12
20
Percentage

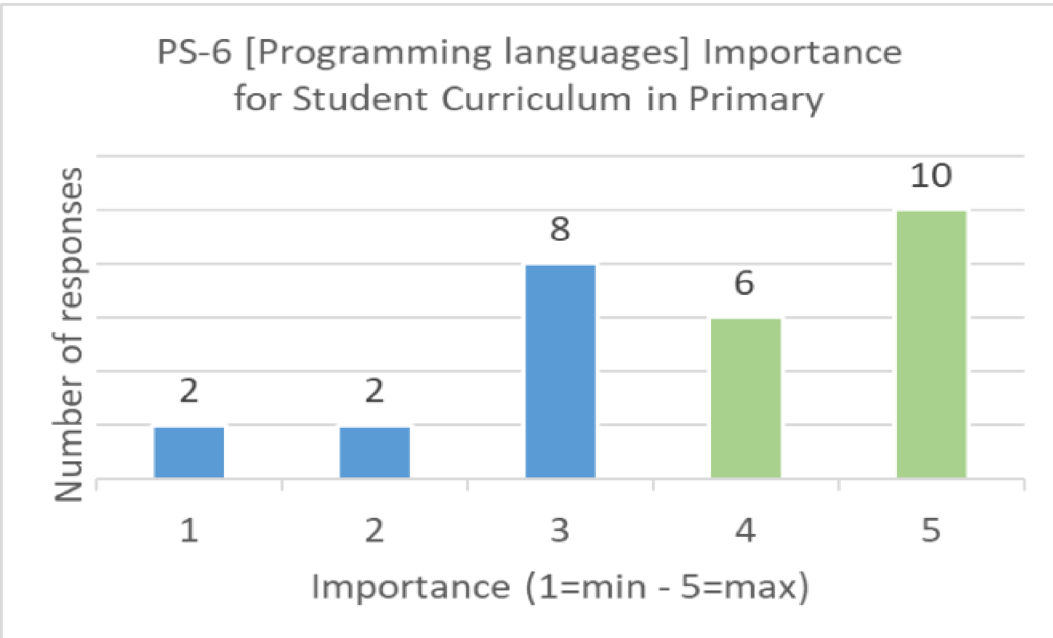

PS-5 [Privacy, safety and security]
% for Student Curriculum in Primary
Number of responses
1
1
10
1
2
9
1
3
0
3
5
8
9
10
15
20
Percentage

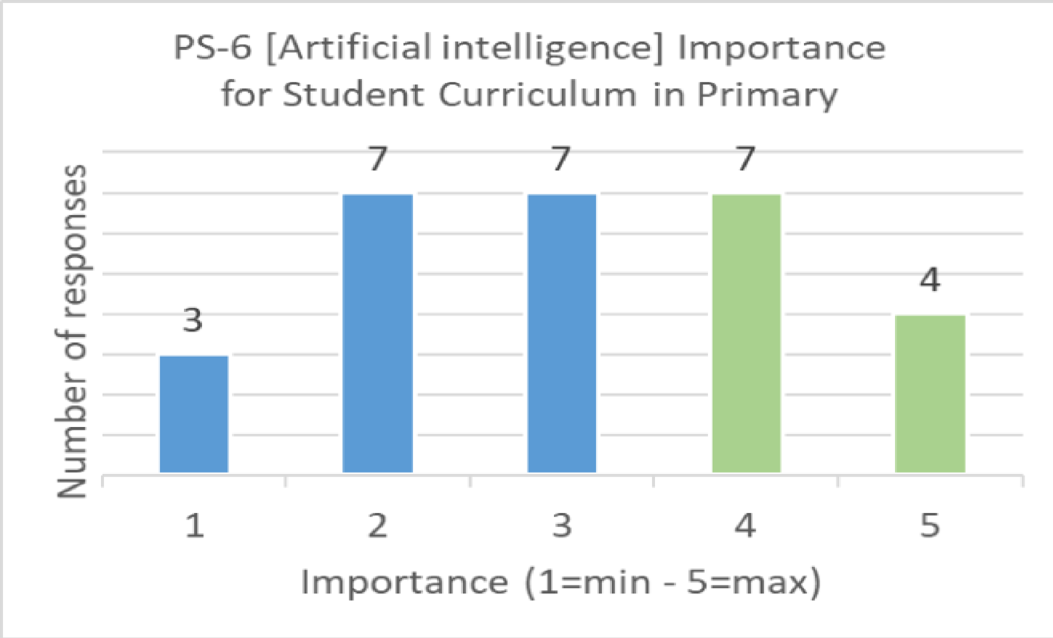

PS-5 [Responsibility and empowerment]
% for Student Curriculum in Primary
Number of responses
3
1
9
1
1
1
1
8
1
1
1
0
3
5
6
7
8
9
10
13
15
20
Percentage

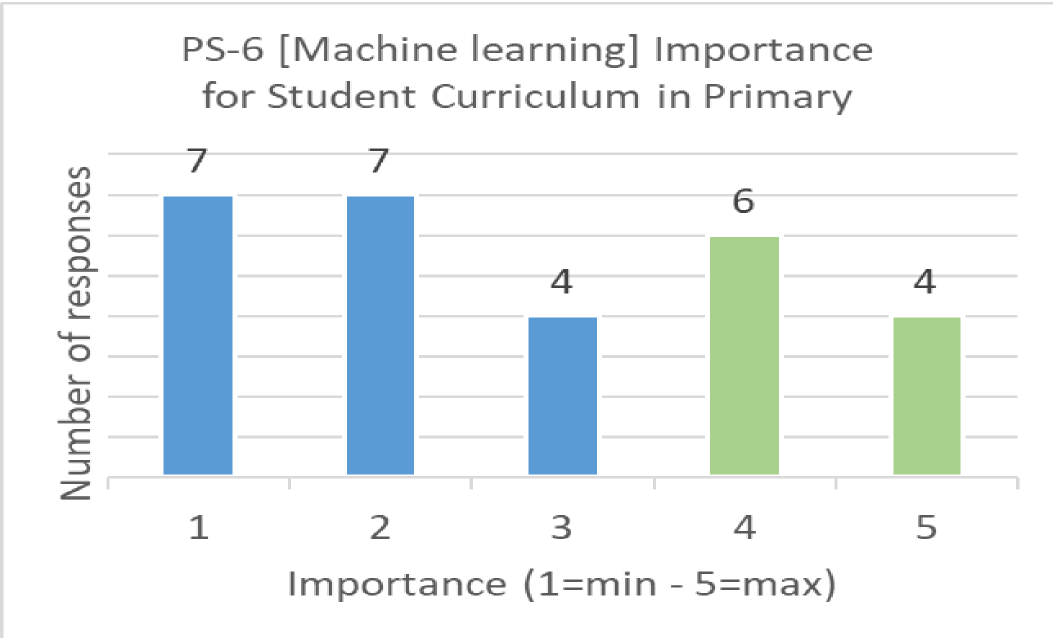
Primary School, student curriculum, contemporary topics

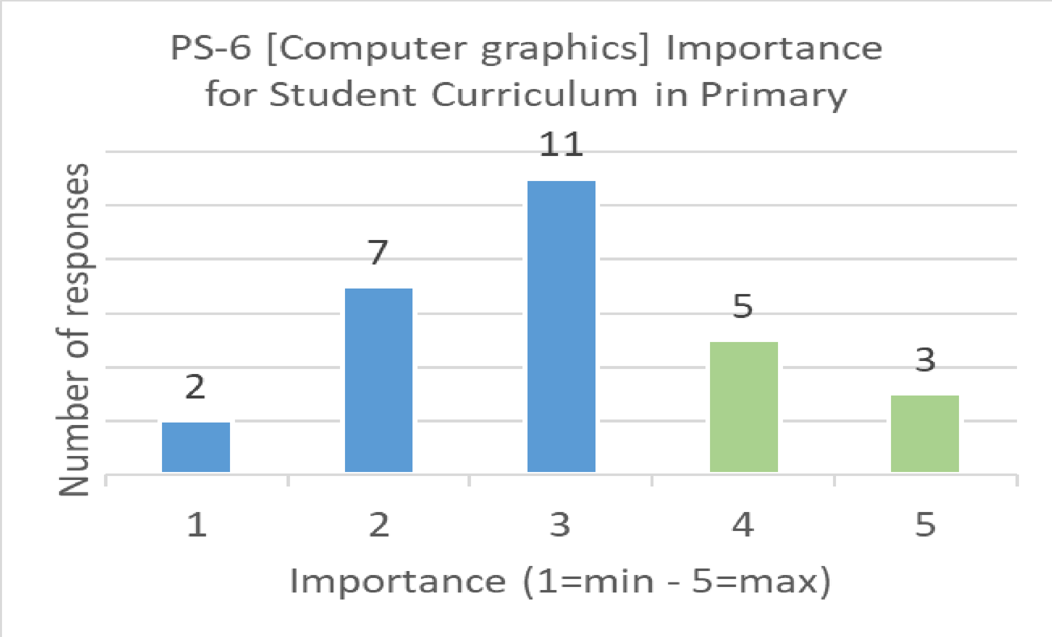
Importance in an ideal informatics curriculum of each of the 10 Contemporary Topics described in the Informatics Reference Framework for School.

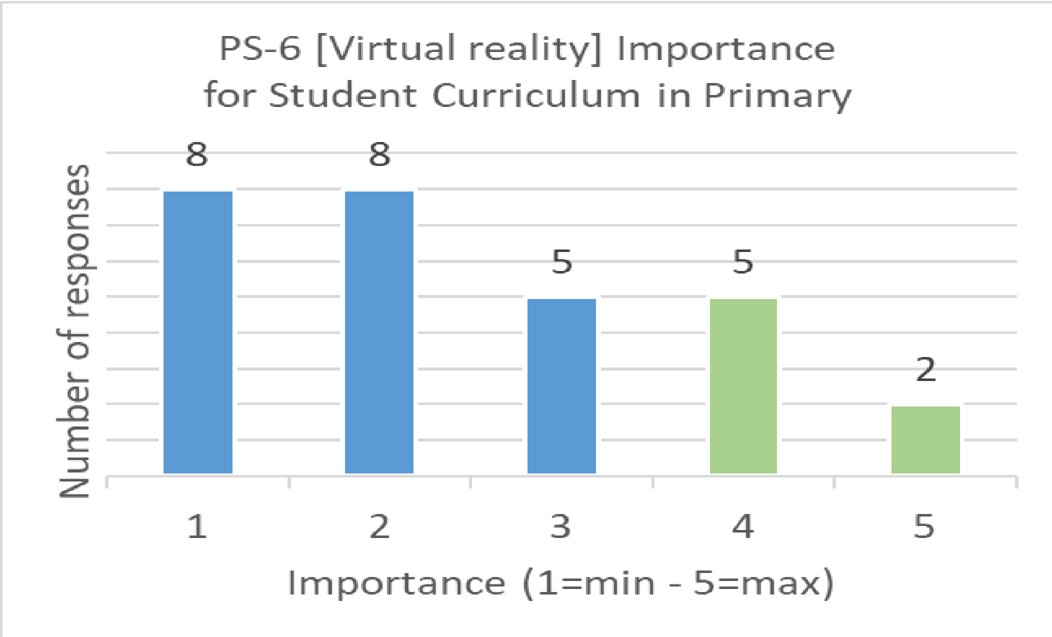


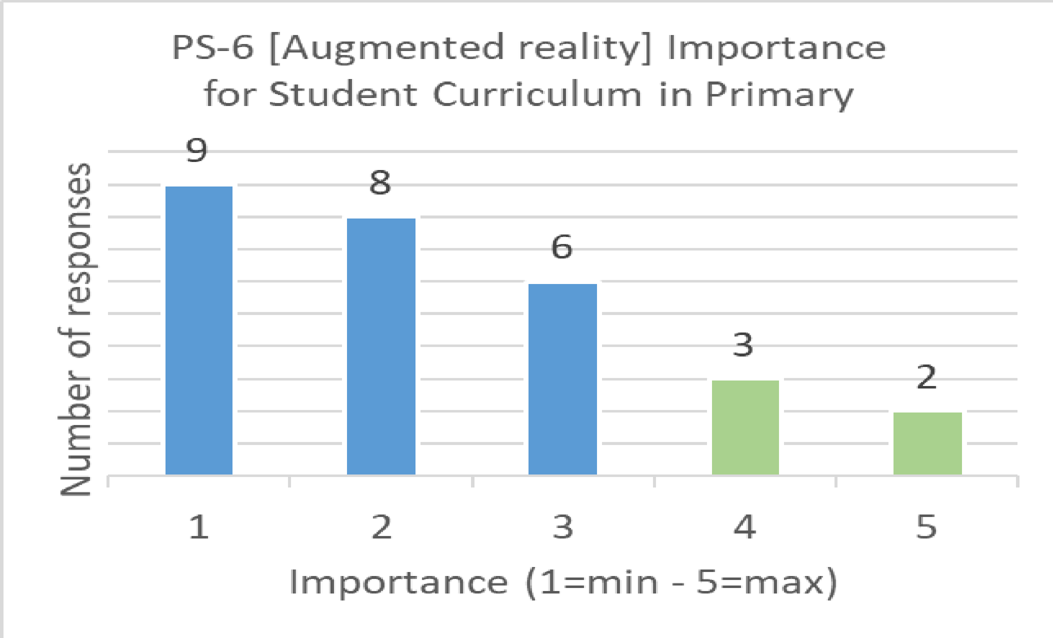


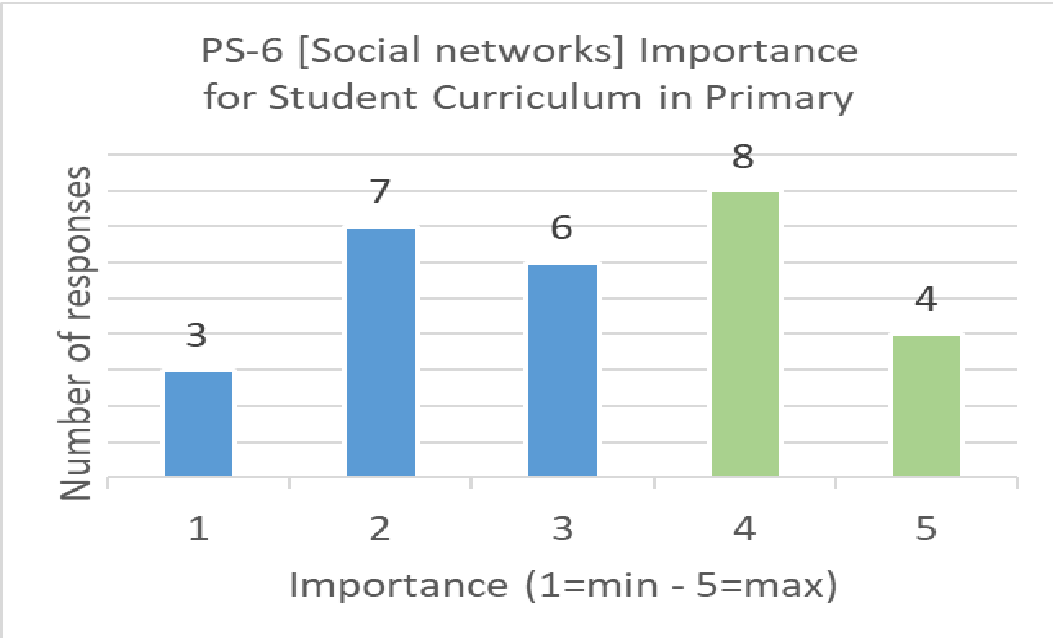

PS-6 [Artificial intelligence] Importance for Student Curriculum in Primary
Number of responses
3
7
7
7
4
1
2
3
4
5
Importance (1=min - 5=max)

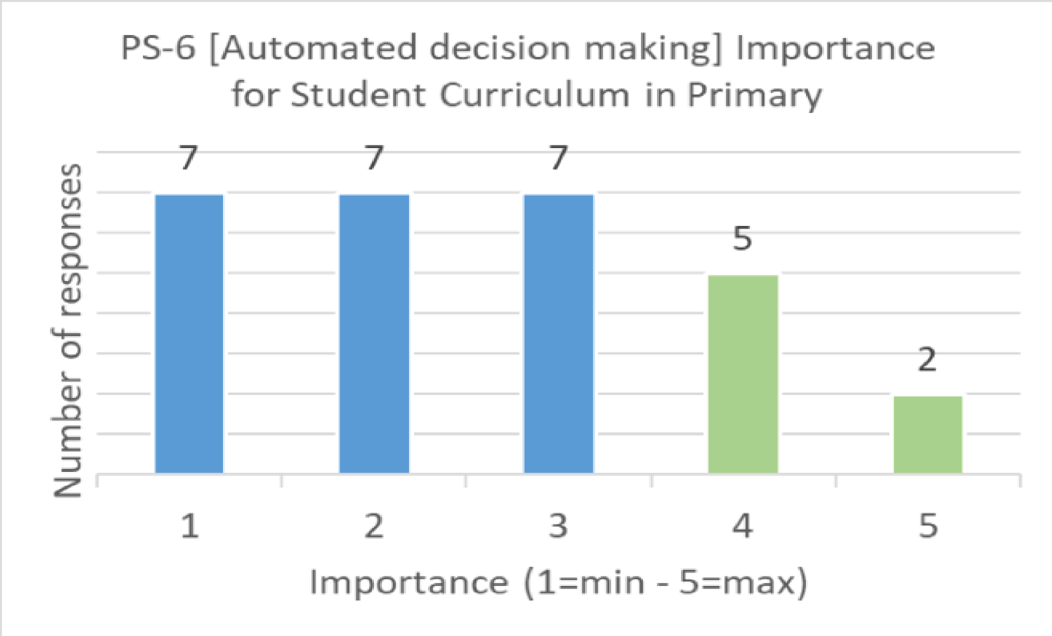

PS-6 [Machine learning] Importance for Student Curriculum in Primary
Number of responses
7
7
4
6
4
1
2
3
4
5
Importance (1=min - 5=max)

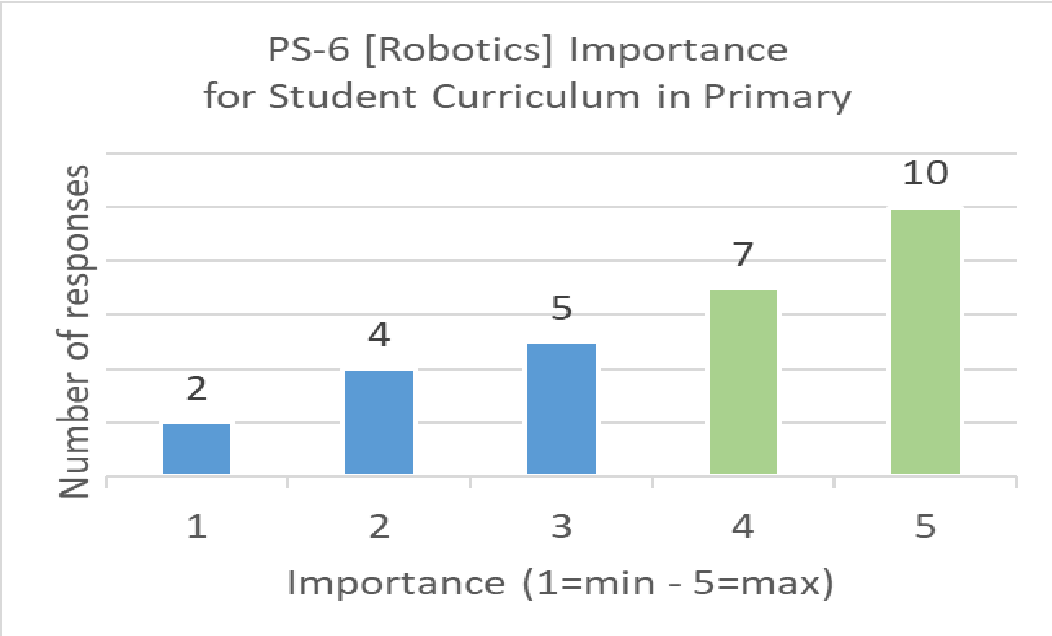

PS-6 [Computer graphics] Importance
for Student Curriculum in Primary
Number of responses
2
7
11
5
3
1
2
3
4
5
Importance (1=min - 5=max)


PS-6 [Virtual reality] Importance
for Student Curriculum in Primary
Number of responses
8
8
5
5
2
1
2
3
4
5
Importance (1=min - 5=max)


PS-6 [Augmented reality] Importance for Student Curriculum in Primary
Number of responses
9
8
6
3
2
1
2
3
4
5
Importance (1=min - 5=max)

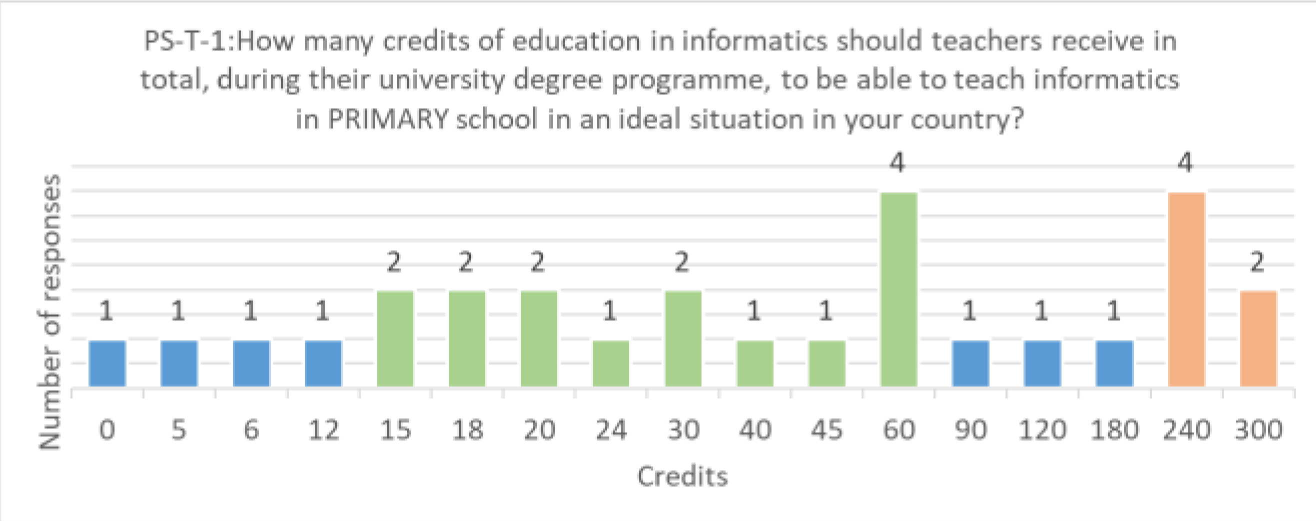

PS-6 [Social networks] Importance for Student Curriculum in Primary
Number of responses
3
7
6
8
4
1
2
3
4
5
Importance (1=min - 5=max)


PS-6 [Automated decision making] Importance
for Student Curriculum in Primary
Number of responses
7
7
7
5
2
1
2
3
4
5
Importance (1=min - 5=max)


PS-6 [Robotics] Importance
for Student Curriculum in Primary
Number of responses
2
4
5
7
10
1
2
3
4
5
Importance (1=min - 5=max)

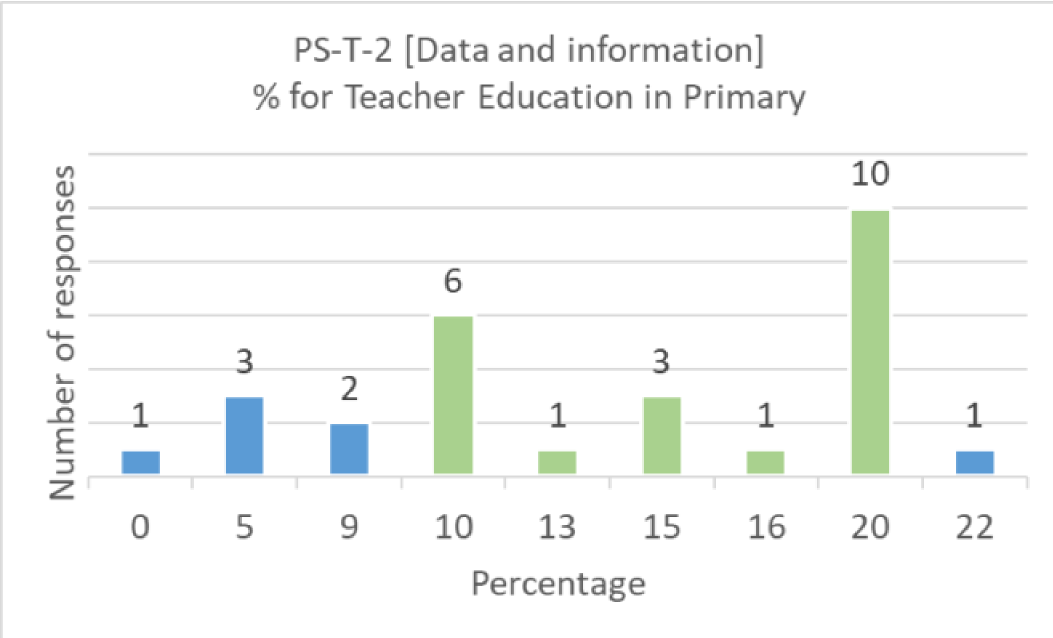
Primary School, teacher education, general question

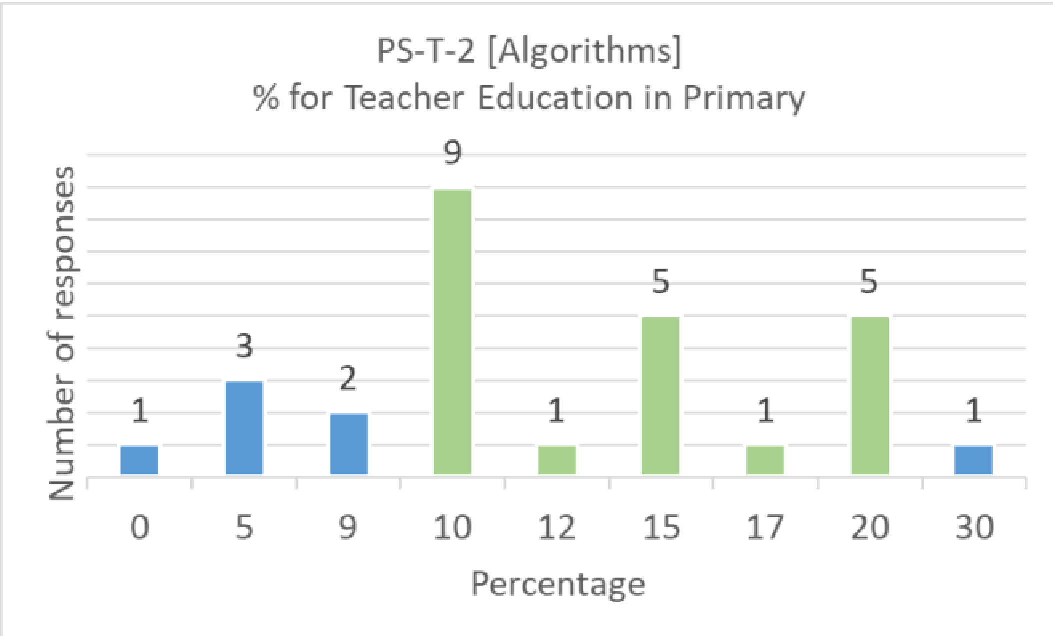
How many credits of education in informatics should **teachers** receive in total, during their university degree programme, to be able to teach informatics in **primary school** in an ideal situation in your country?

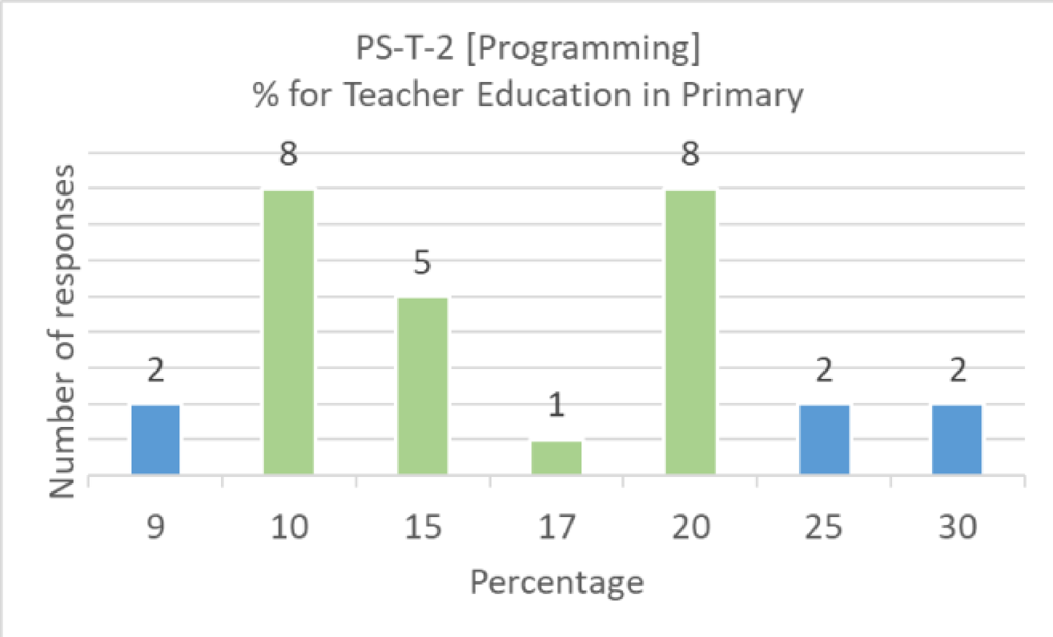


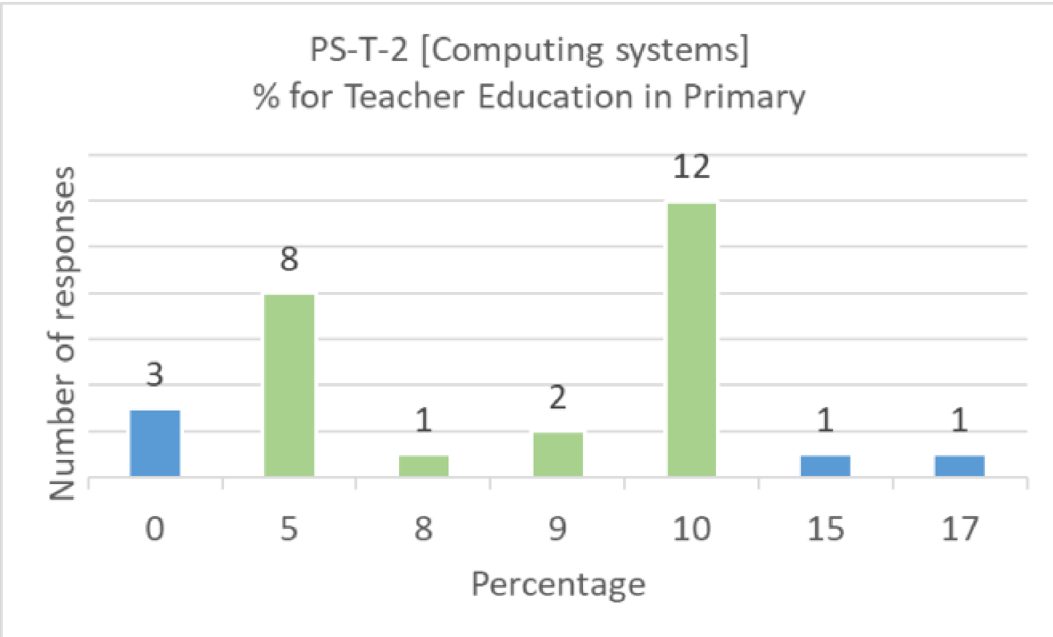
Primary School, teacher education, core topic areas

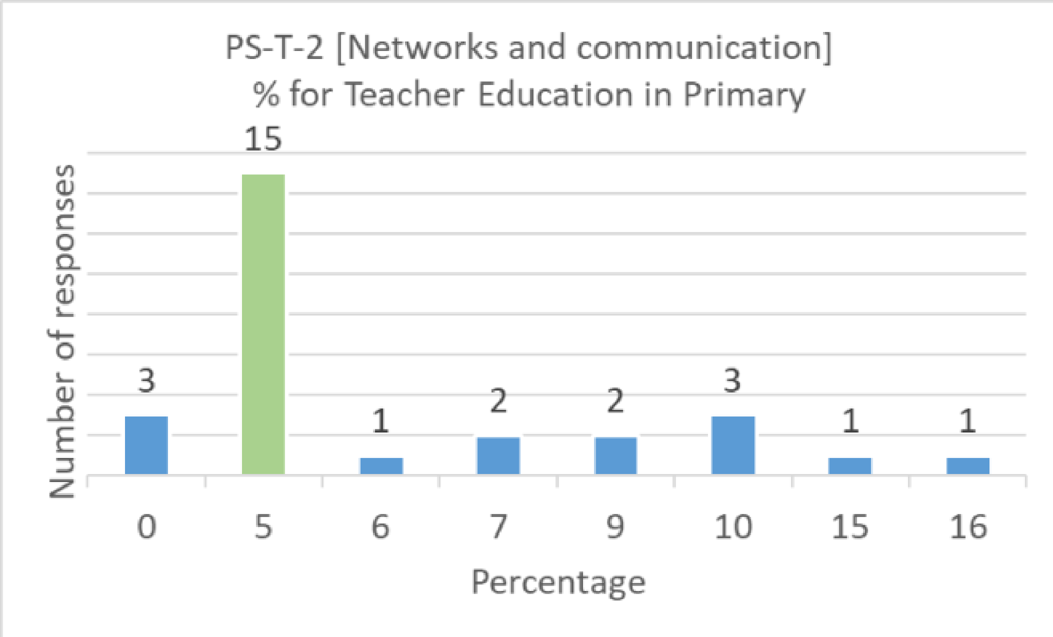
Percentage of informatics curriculum time for teacher education ideally allocated to each of the 11 Core Topic Areas described in the Informatics Reference Framework for School.

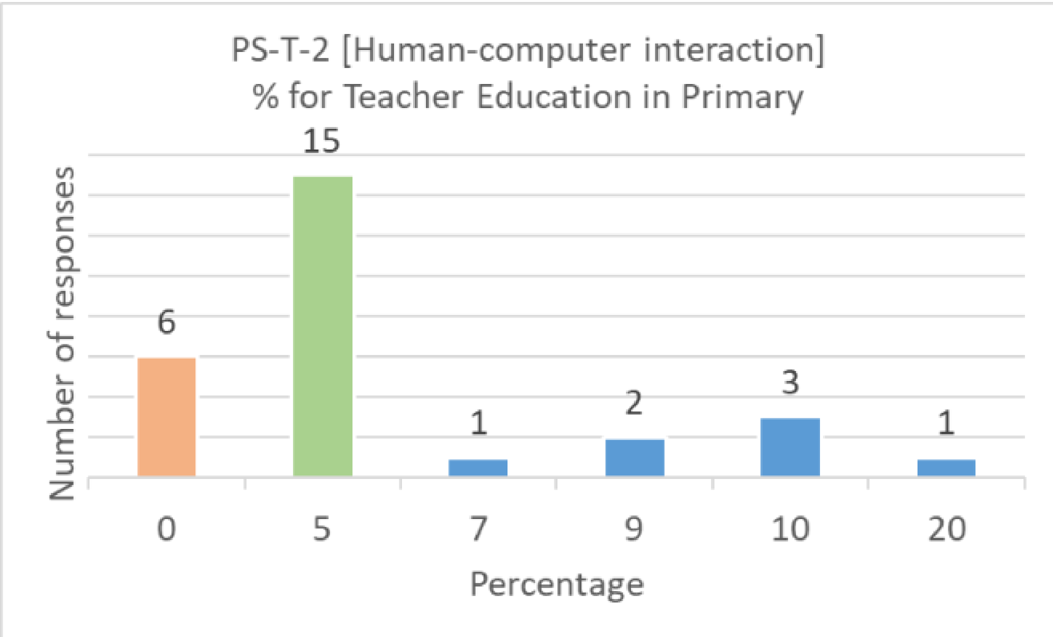


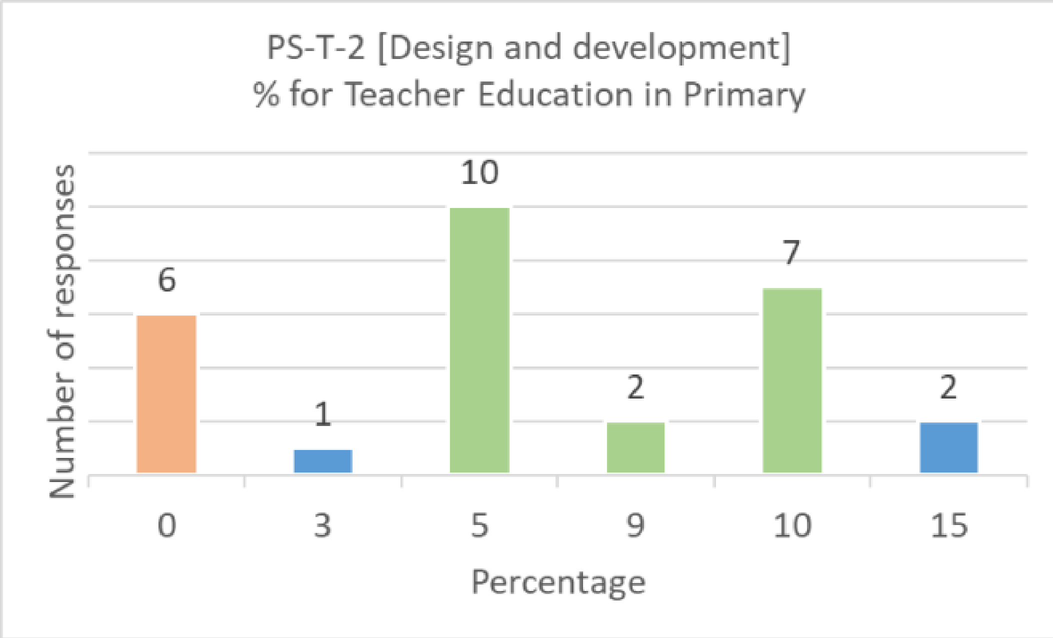


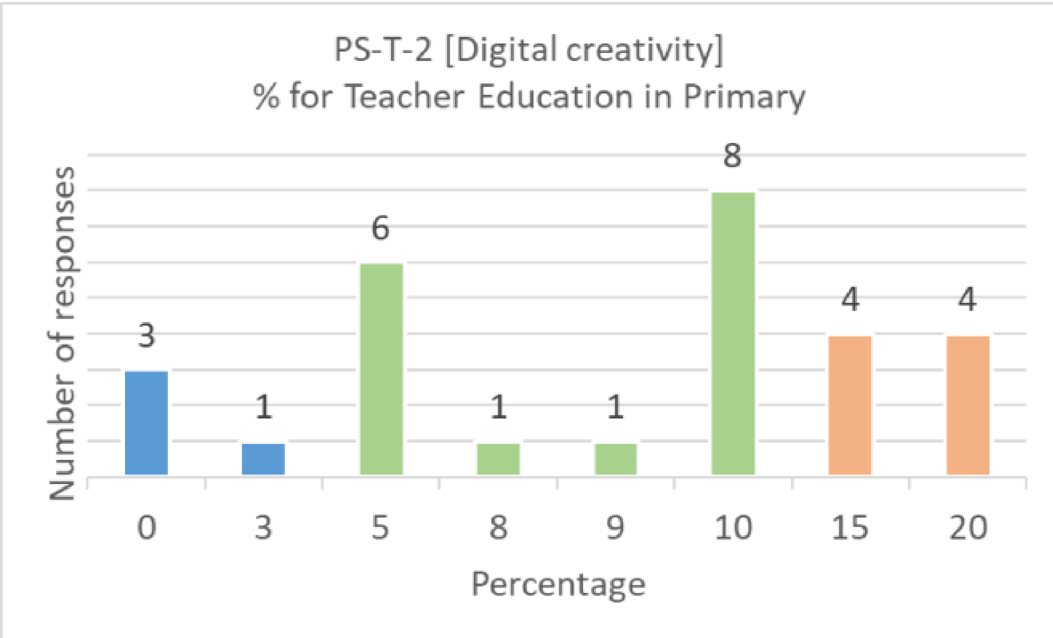

PS-T-2 [Programming]
% for Teacher Education in Primary
Number of responses
Percentage
9
10
15
17
20
25
30
2
8
5
1
8
2
2

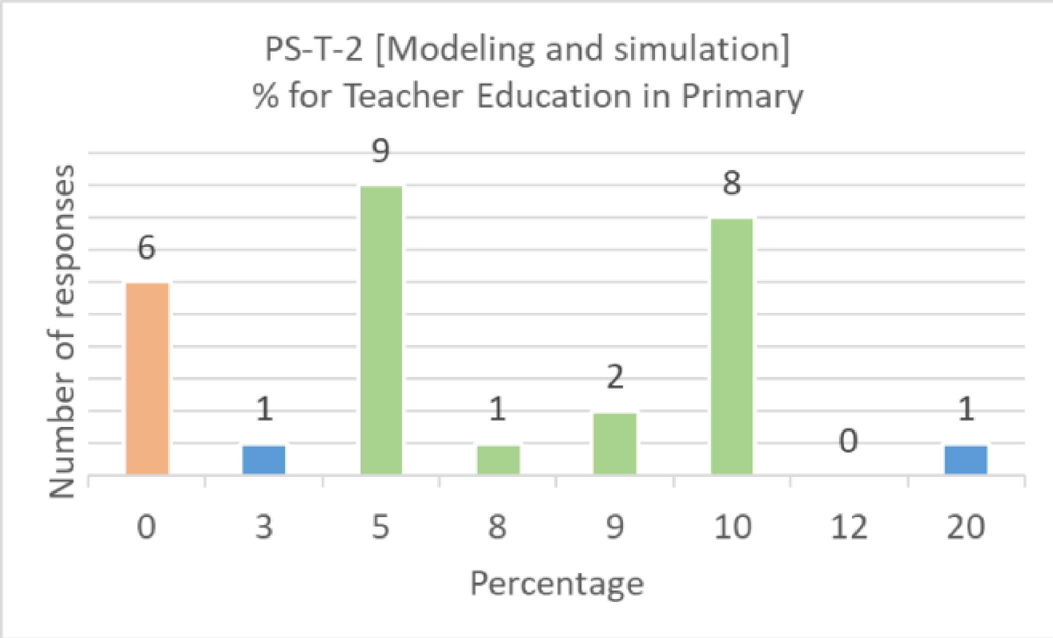

PS-T-2 [Computing systems]
% for Teacher Education in Primary
Number of responses
Percentage
0
5
8
9
10
15
17
3
8
1
2
12
1
1

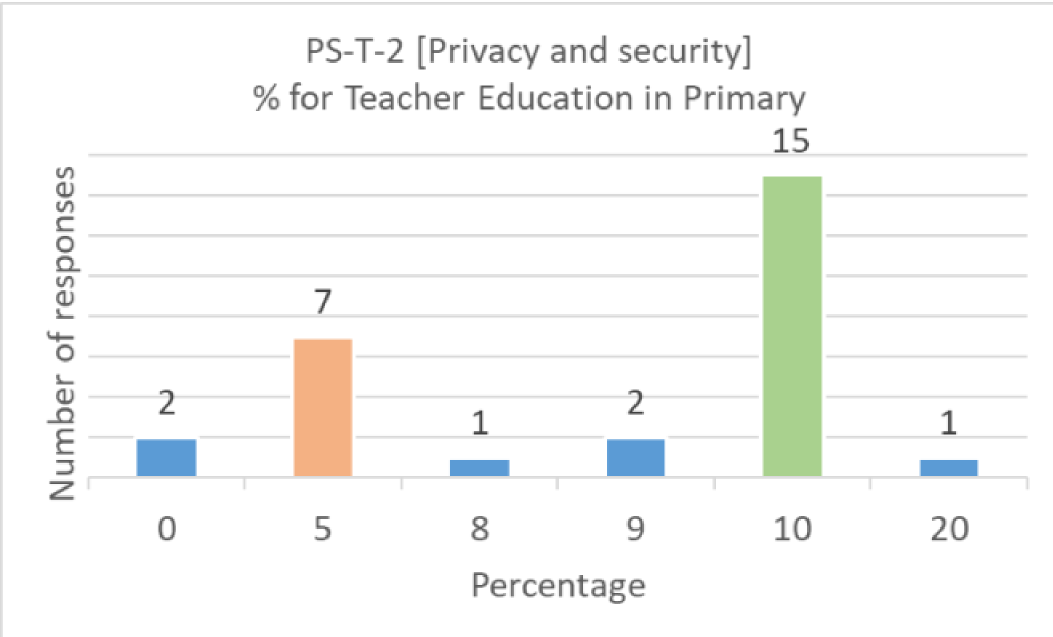

PS-T-2 [Networks and communication]
% for Teacher Education in Primary
Number of responses
Percentage
0
5
6
7
9
10
15
16
3
15
1
2
2
3
1
1

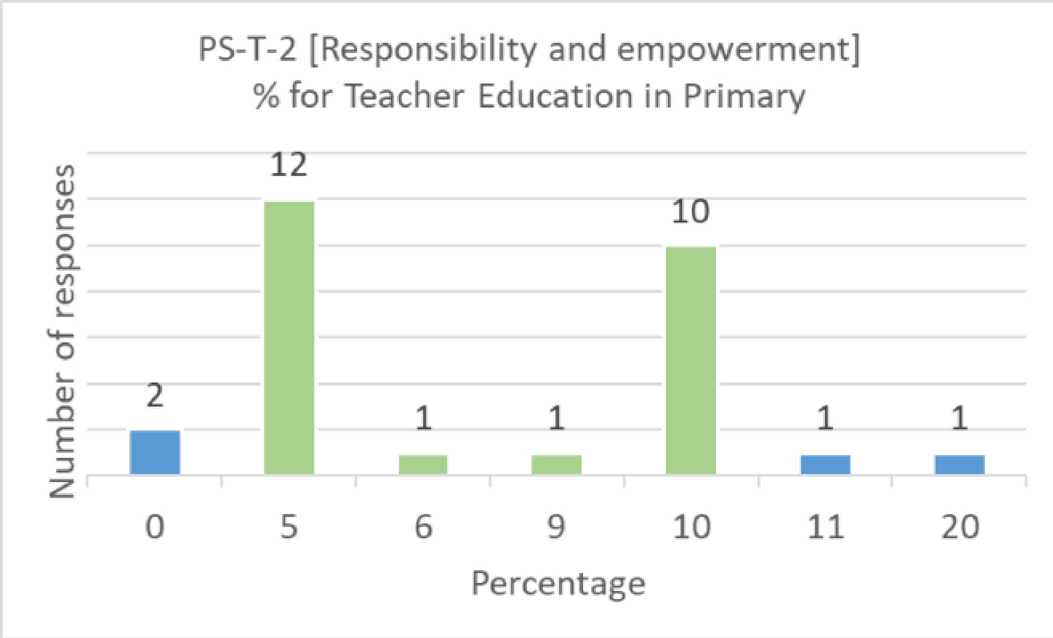

PS-T-2 [Human-computer interaction]
% for Teacher Education in Primary
Number of responses
Percentage
0
5
7
9
10
20
6
15
1
2
3
1


PS-T-2 [Design and development]
% for Teacher Education in Primary
Number of responses
6
1
10
2
7
2
0
3
5
9
10
15
Percentage


PS-T-2 [Digital creativity]
% for Teacher Education in Primary
Number of responses
3
1
6
1
1
8
4
4
0
3
5
8
9
10
15
20
Percentage

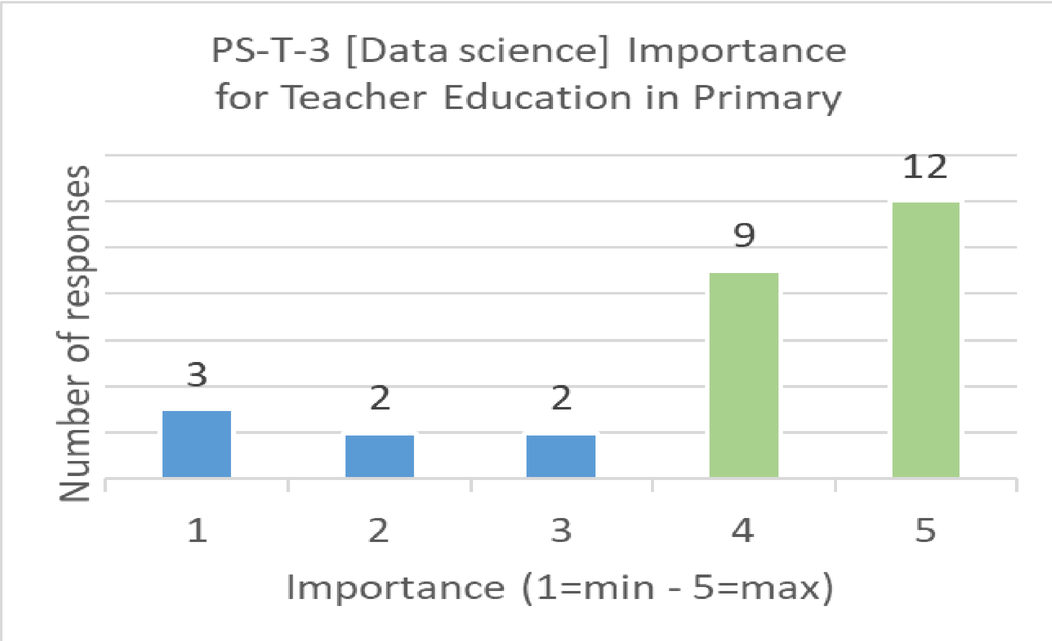

PS-T-2 [Modeling and simulation]
% for Teacher Education in Primary
Number of responses
6
1
9
1
2
8
0
1
0
3
5
8
9
10
12
20
Percentage

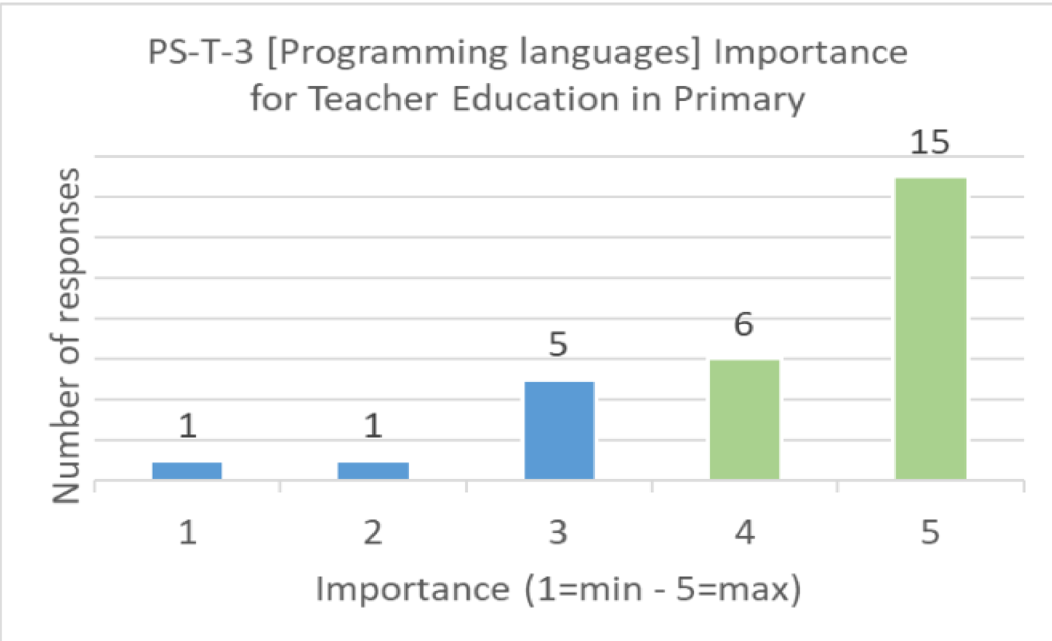

PS-T-2 [Privacy and security]
% for Teacher Education in Primary
Number of responses
2
7
1
2
15
1
0
5
8
9
10
20
Percentage

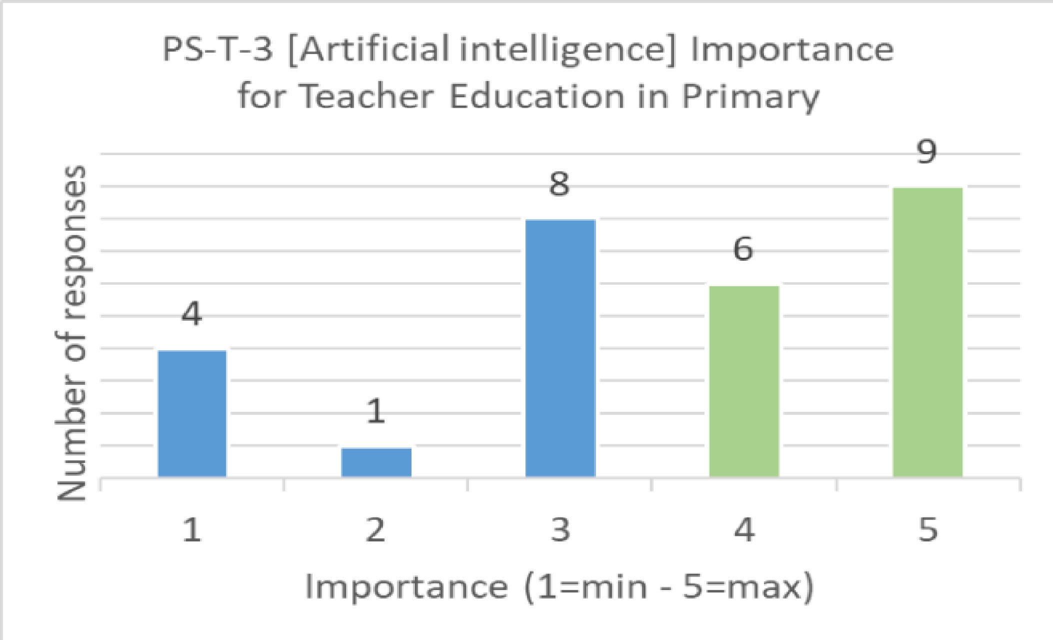

PS-T-2 [Responsibility and empowerment]
% for Teacher Education in Primary
Number of responses
2
12
1
1
10
1
1
0
5
6
9
10
11
20
Percentage

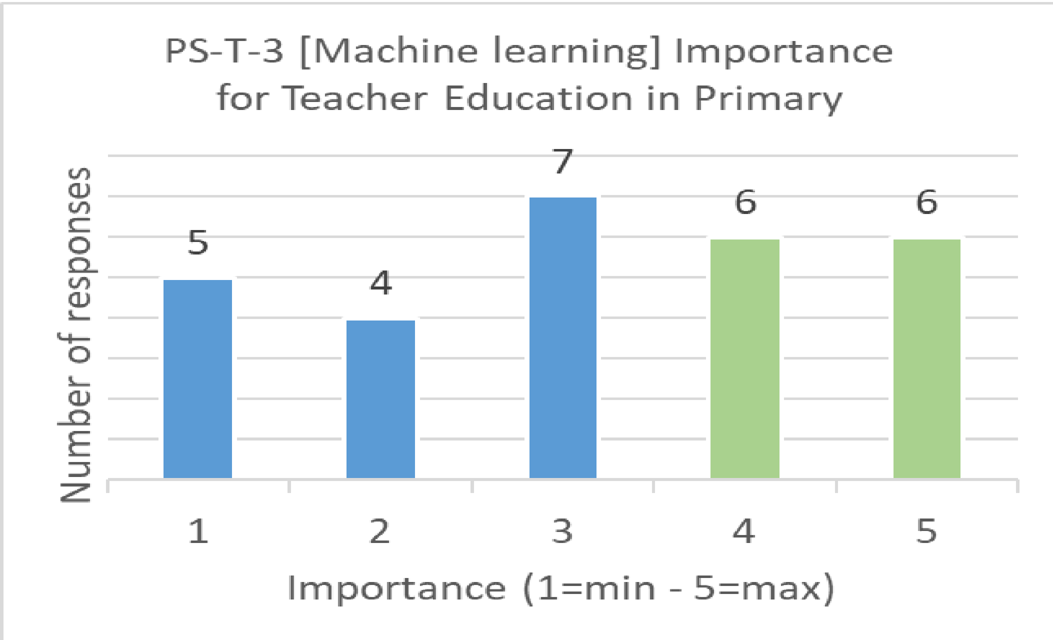
Primary School, teacher education, contemporary topics

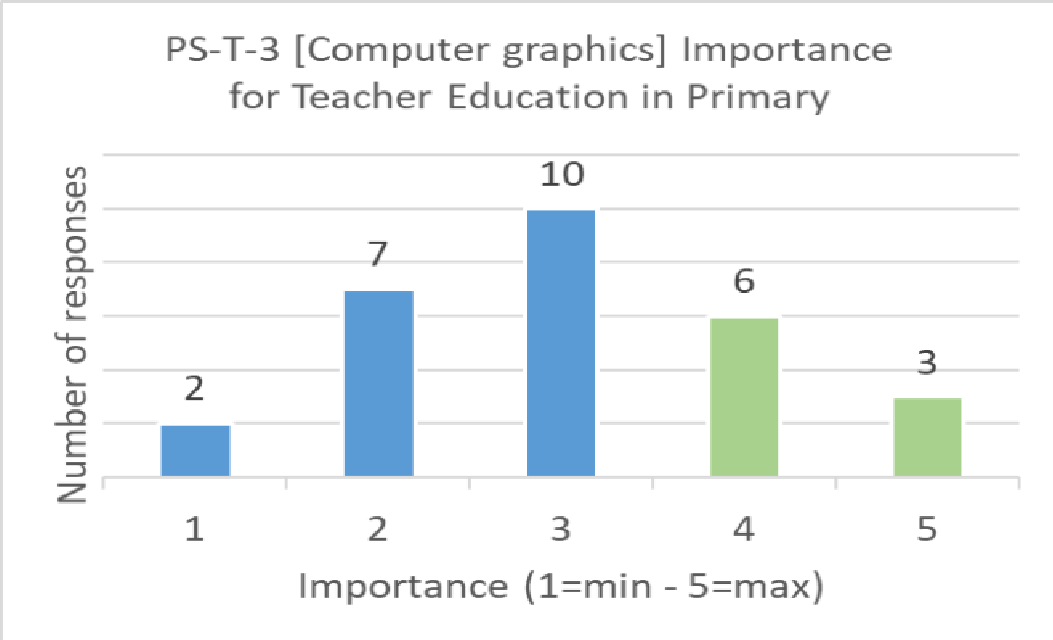
Importance in an ideal informatics curriculum for teacher education of each of the 10 Contemporary Topics described in the Informatics Reference Framework for School.

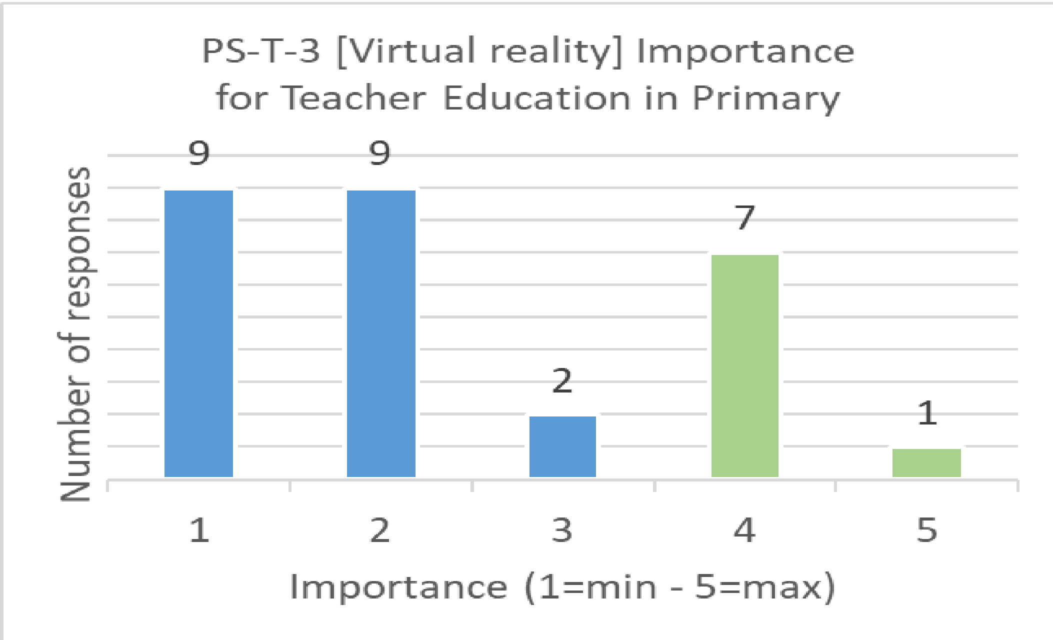


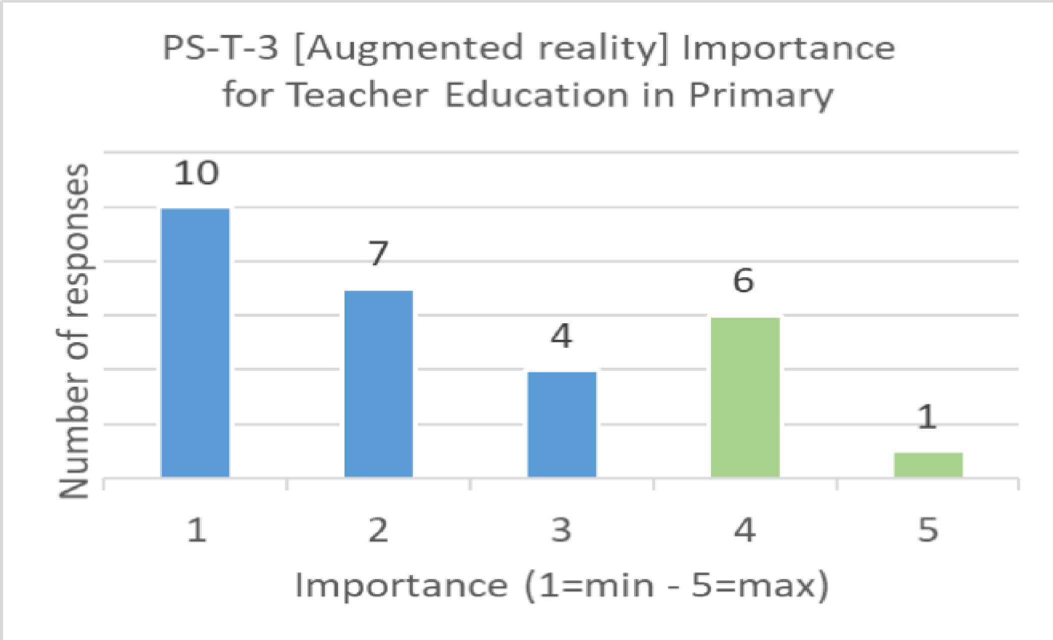


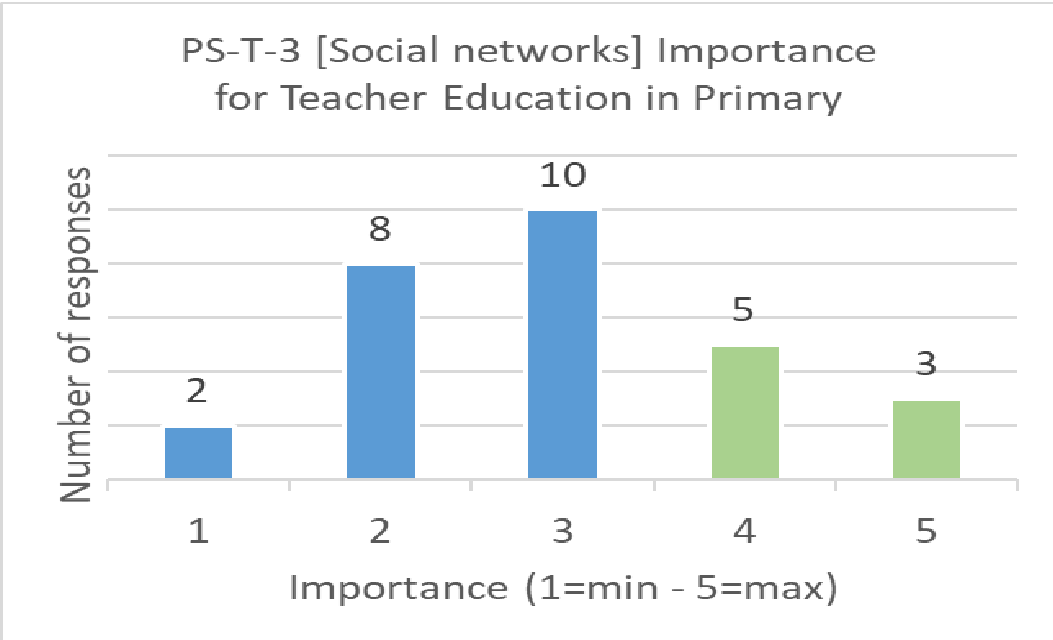

PS-T-3 [Artificial intelligence] Importance for Teacher Education in Primary
Number of responses
4
1
8
6
9
1
2
3
4
5
Importance (1=min - 5=max)

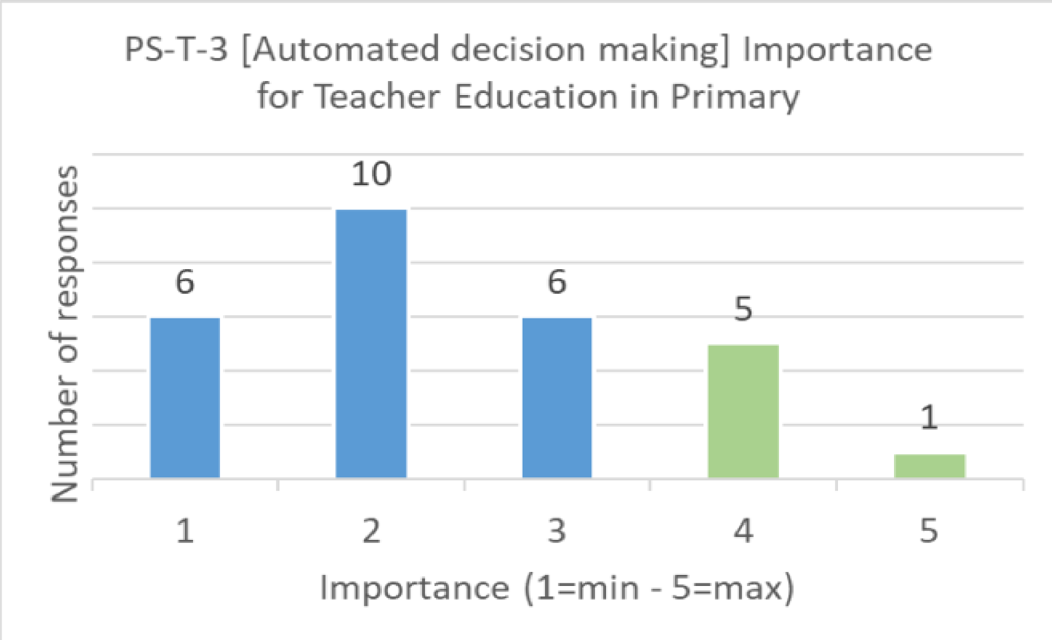

PS-T-3 [Machine learning] Importance for Teacher Education in Primary
Number of responses
5
4
7
6
6
1
2
3
4
5
Importance (1=min - 5=max)

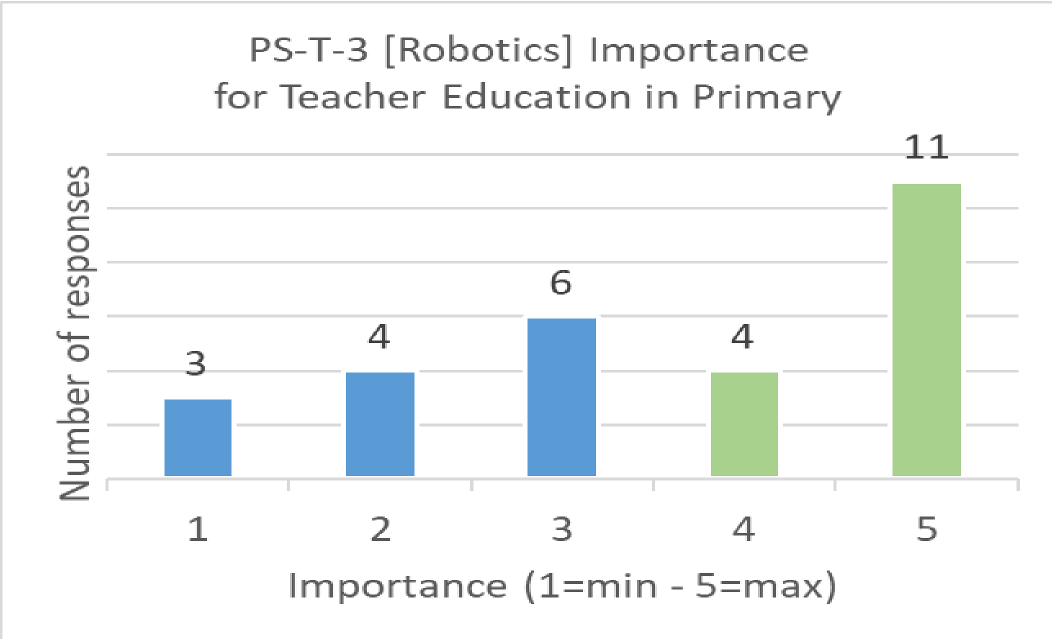

PS-T-3 [Computer graphics] Importance
for Teacher Education in Primary
Number of responses
2
7
10
6
3
1
2
3
4
5
Importance (1=min - 5=max)


PS-T-3 [Virtual reality] Importance
for Teacher Education in Primary
Number of responses
9
9
2
7
1
1
2
3
4
5
Importance (1=min - 5=max)

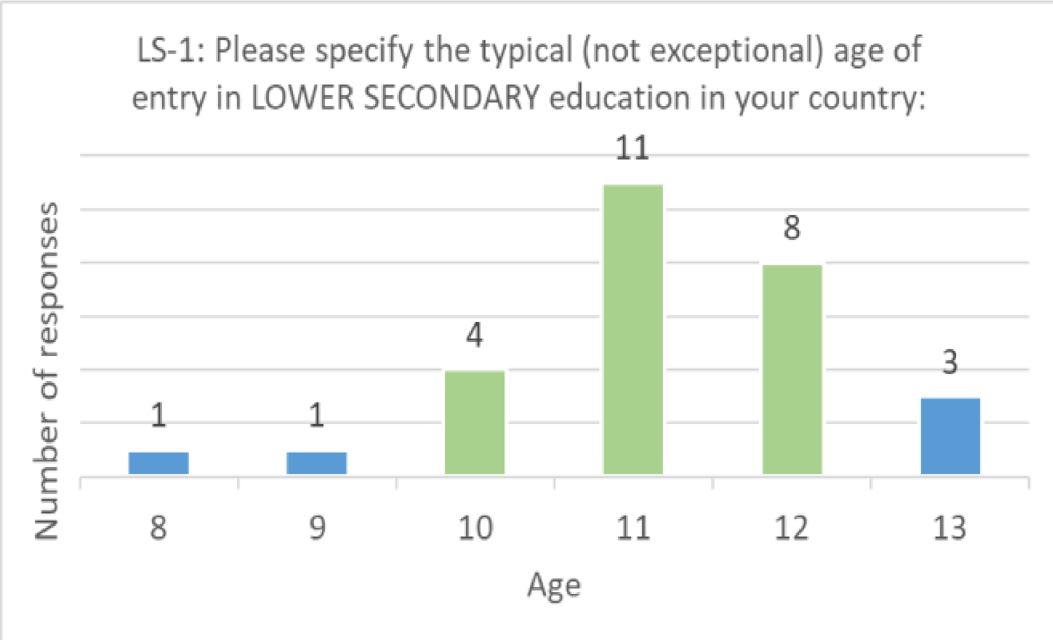

PS-T-3 [Augmented reality] Importance
for Teacher Education in Primary
Number of responses
10
7
6
4
1
1
2
3
4
5
Importance (1=min - 5=max)

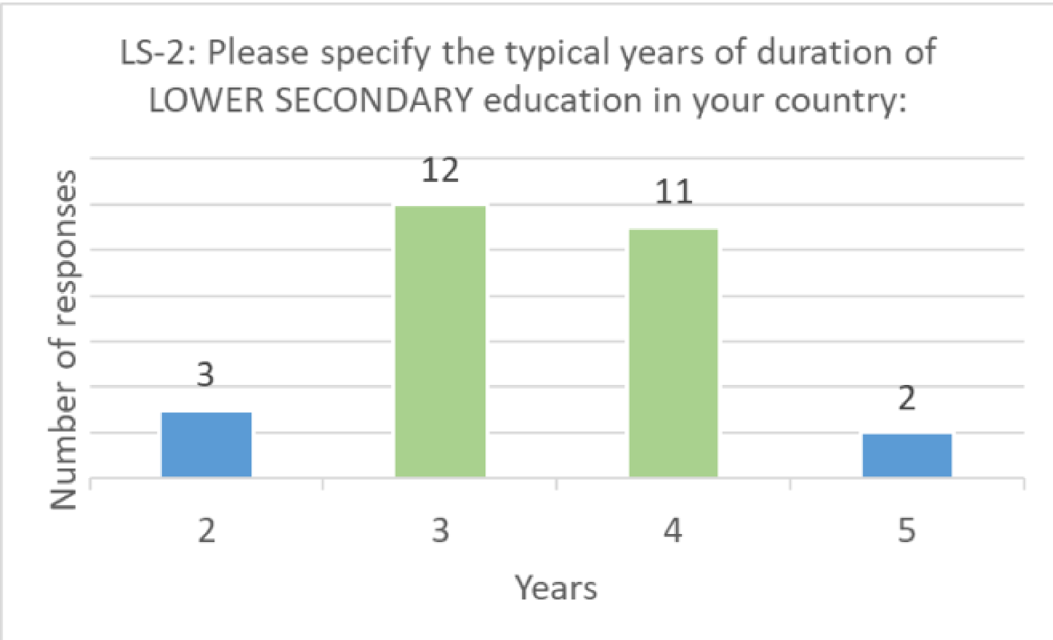

PS-T-3 [Social networks] Importance
for Teacher Education in Primary
Number of responses
10
8
5
3
2
1
2
3
4
5
Importance (1=min - 5=max)

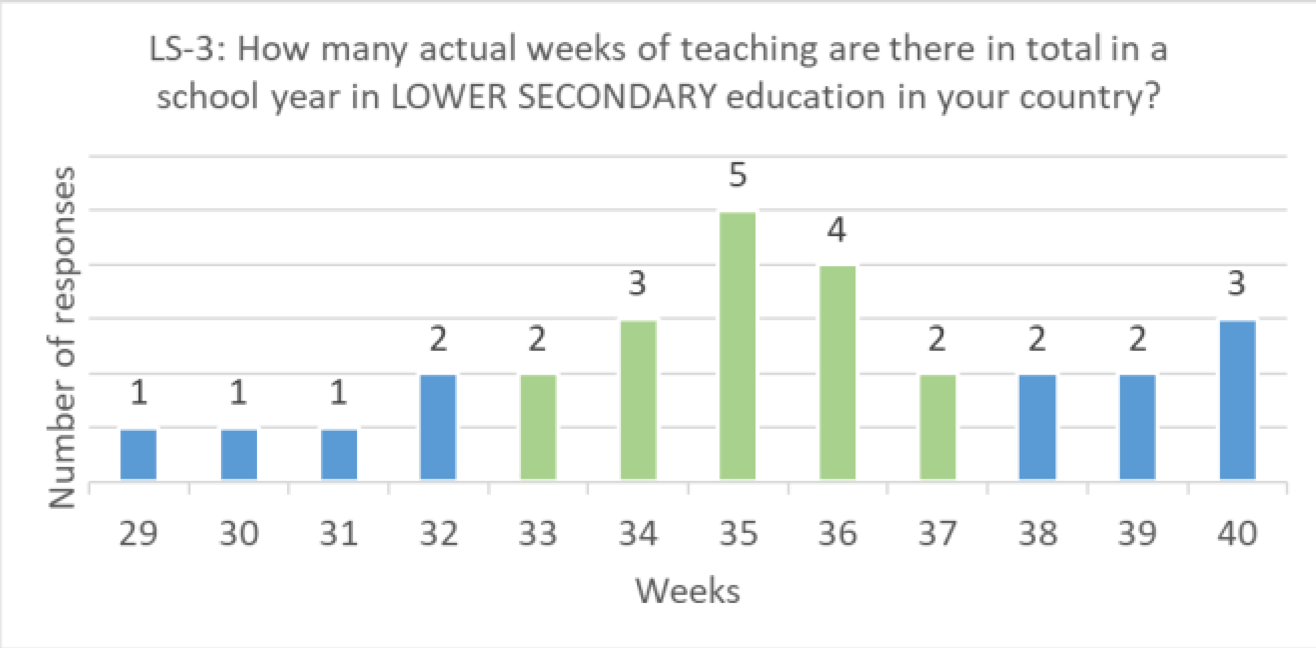

PS-T-3 [Automated decision making] Importance
for Teacher Education in Primary
Number of responses
6
10
6
5
1
1
2
3
4
5
Importance (1=min - 5=max)

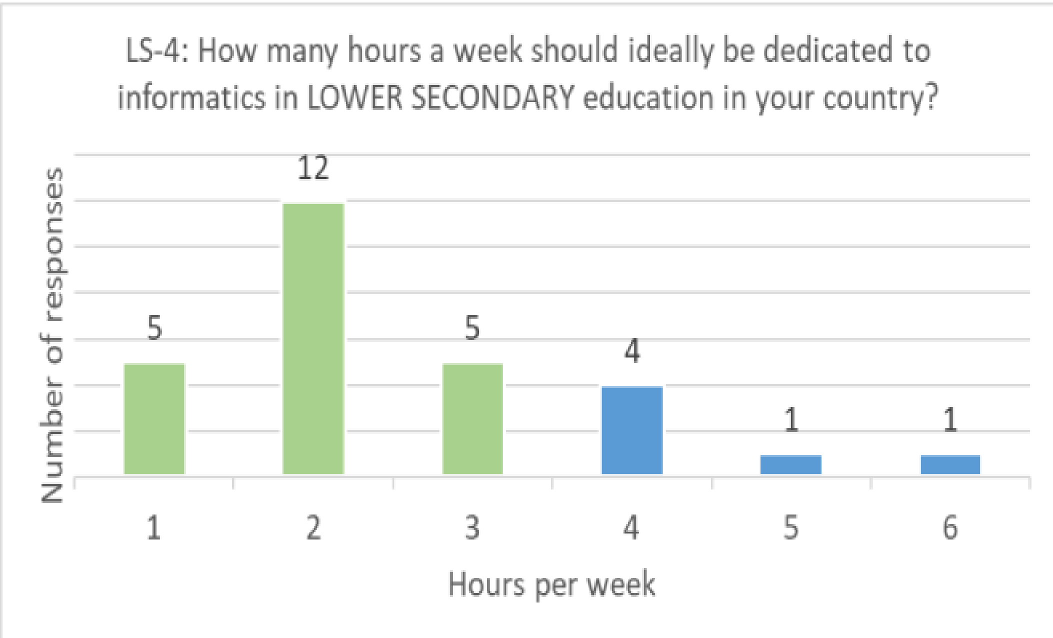

PS-T-3 [Robotics] Importance
for Teacher Education in Primary
Number of responses
3
4
6
4
11
1
2
3
4
5
Importance (1=min - 5=max)

Lower Secondary School, teacher education, general questions



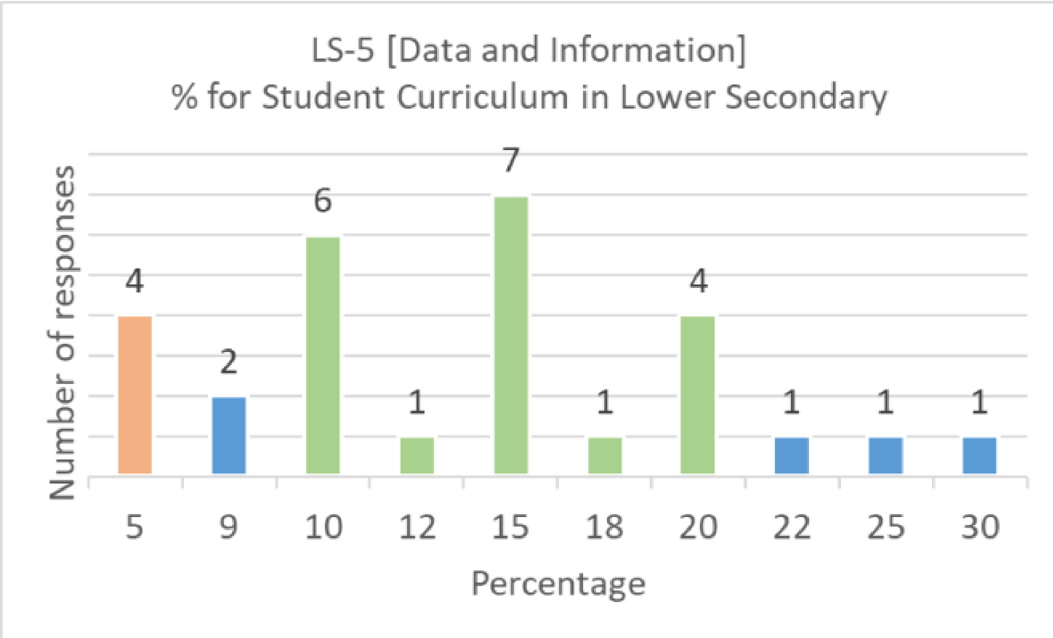


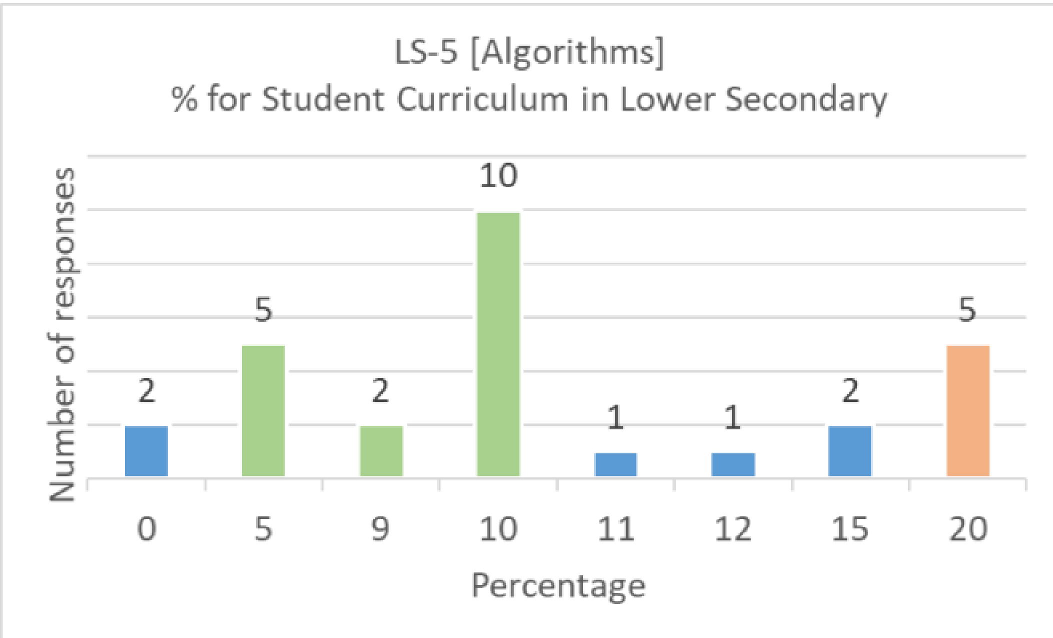

LS-3: How many actual weeks of teaching are there in total in a school year in LOWER SECONDARY education in your country?
Number of responses
1
1
1
2
2
3
5
4
2
2
2
3
29
30
31
32
33
34
35
36
37
38
39
40
Weeks

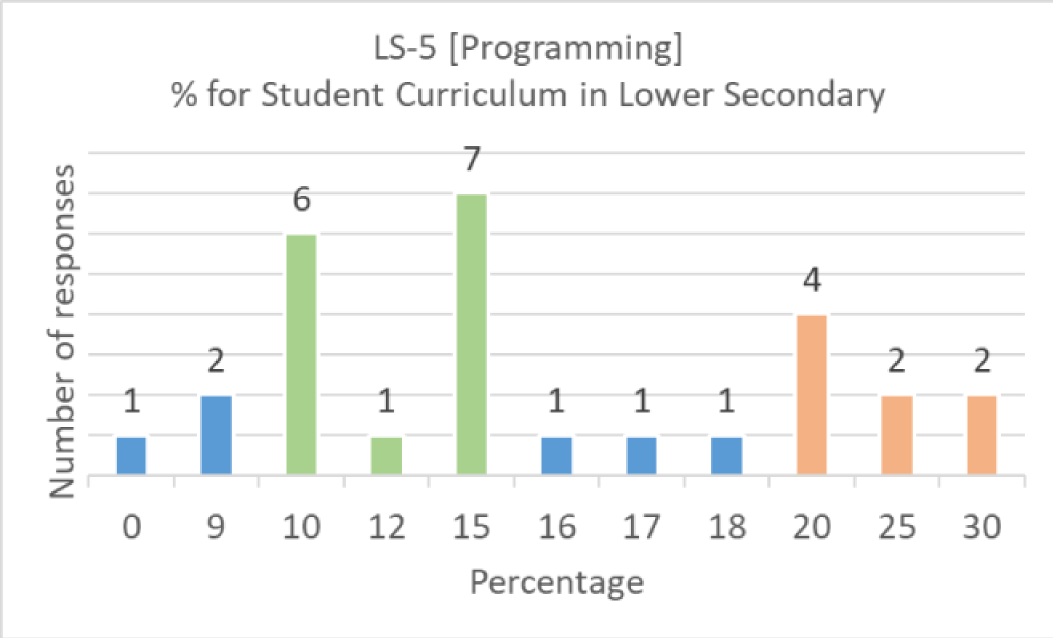

LS-4: How many hours a week should ideally be dedicated to informatics in LOWER SECONDARY education in your country?
Number of responses
5
12
5
4
1
1
1
2
3
4
5
6
Hours per week

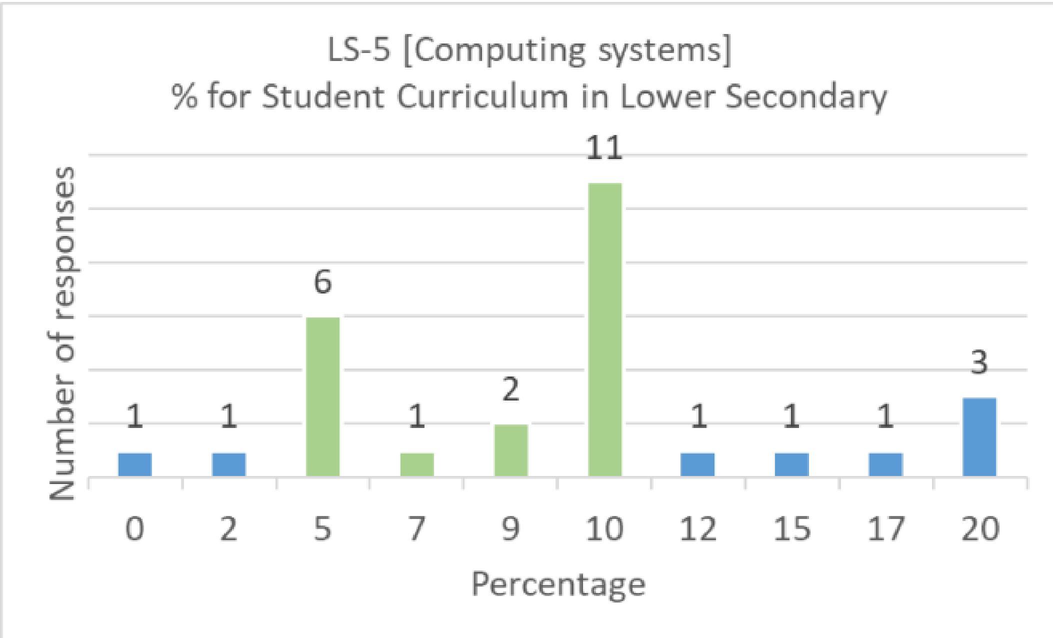
Lower Secondary School, student curriculum, core topic areas

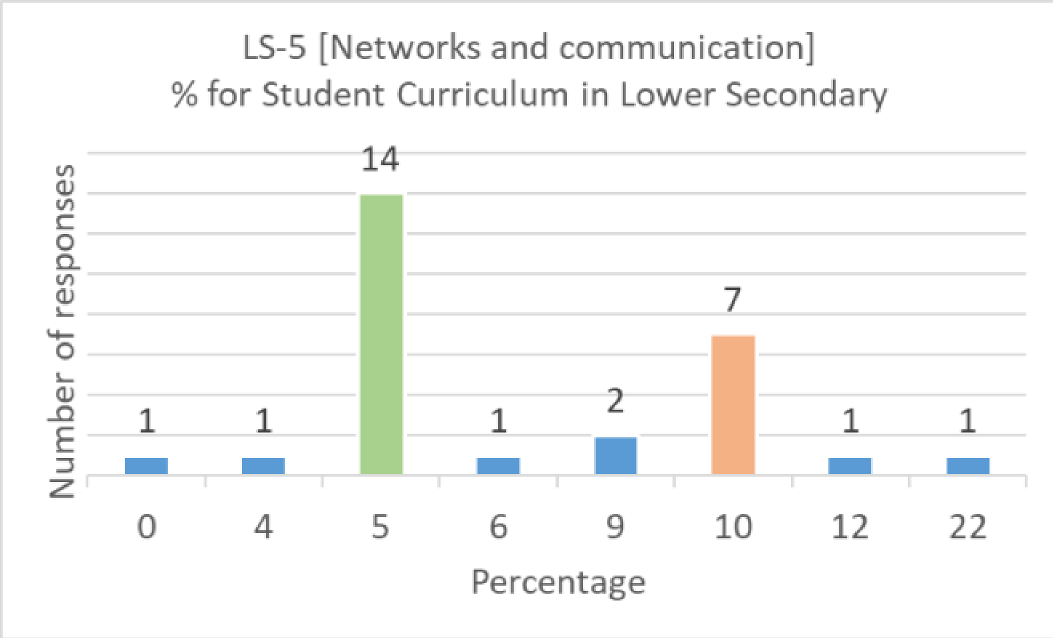
Percentage of informatics curriculum time ideally allocated to each of the 11 Core Topic Areas described in the Informatics Reference Framework for School.

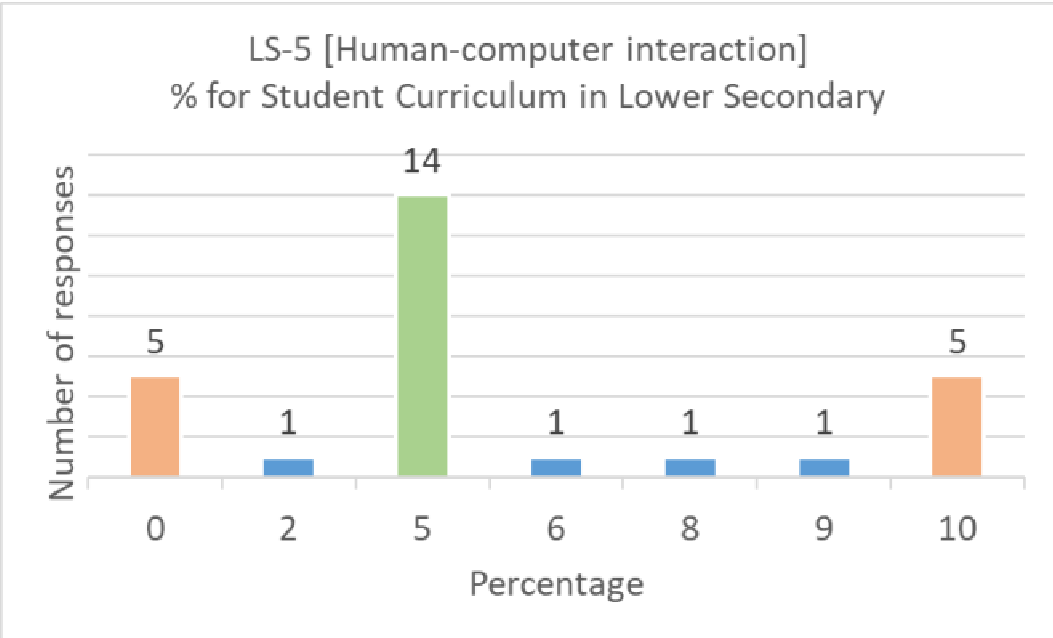


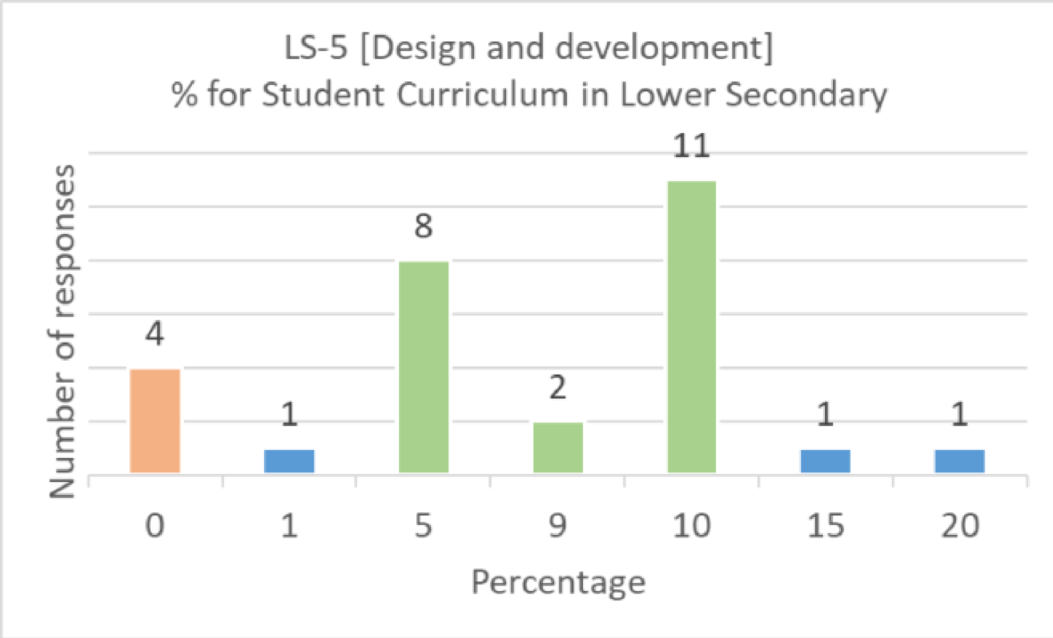


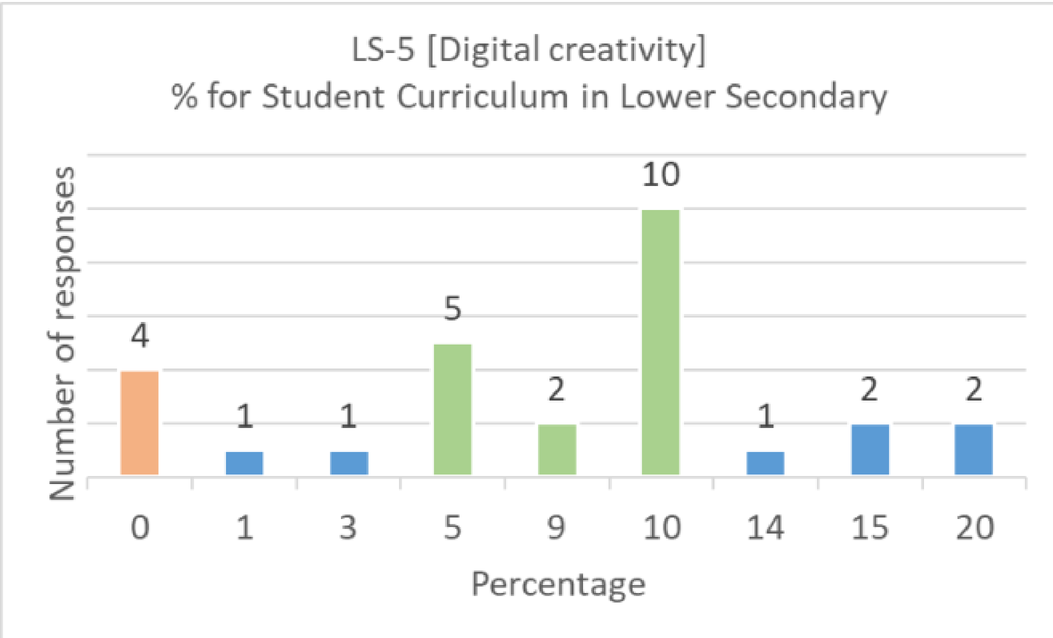

LS-5 [Programming]
% for Student Curriculum in Lower Secondary
Number of responses
1
2
6
1
7
1
1
1
4
2
2
0
9
10
12
15
16
17
18
20
25
30
Percentage

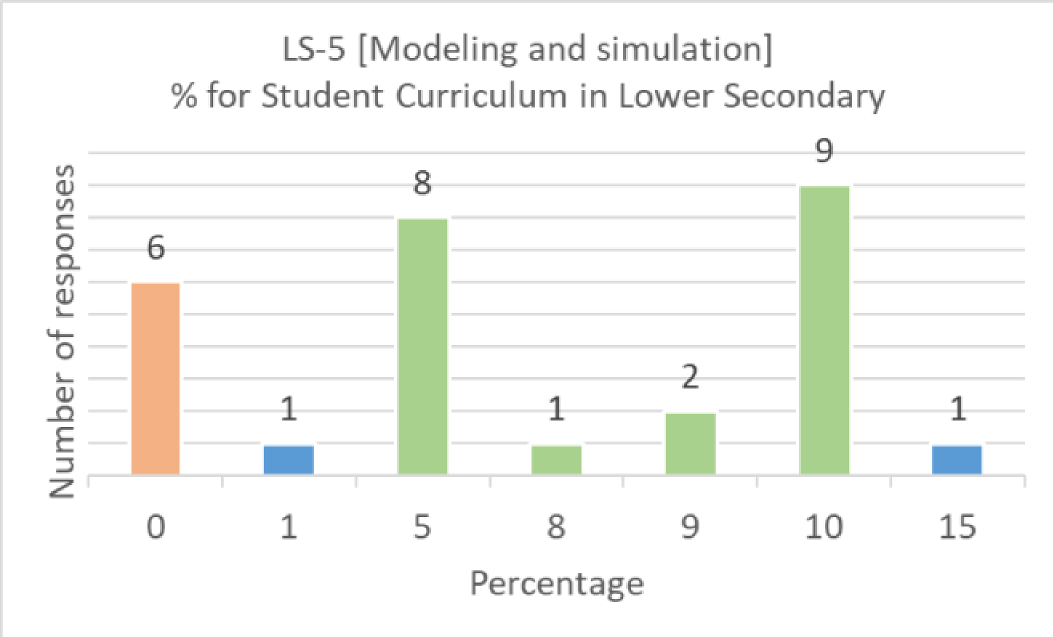

LS-5 [Computing systems]
% for Student Curriculum in Lower Secondary
Number of responses
1
1
6
1
2
11
1
1
1
3
0
2
5
7
9
10
12
15
17
20
Percentage

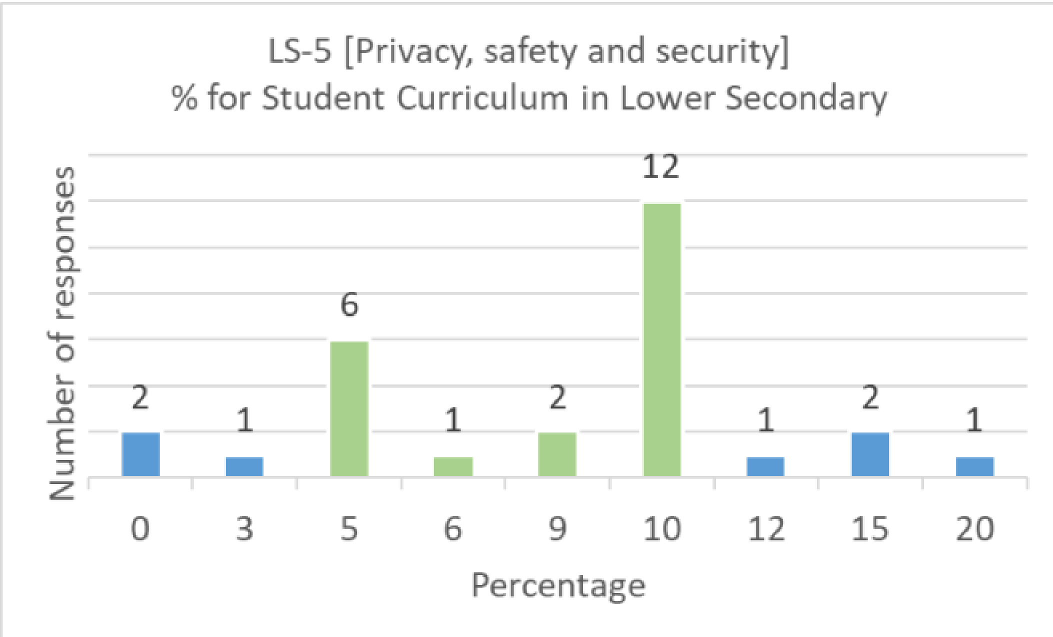

LS-5 [Networks and communication]
% for Student Curriculum in Lower Secondary
Number of responses
1
1
14
1
2
7
1
1
0
4
5
6
9
10
12
22
Percentage

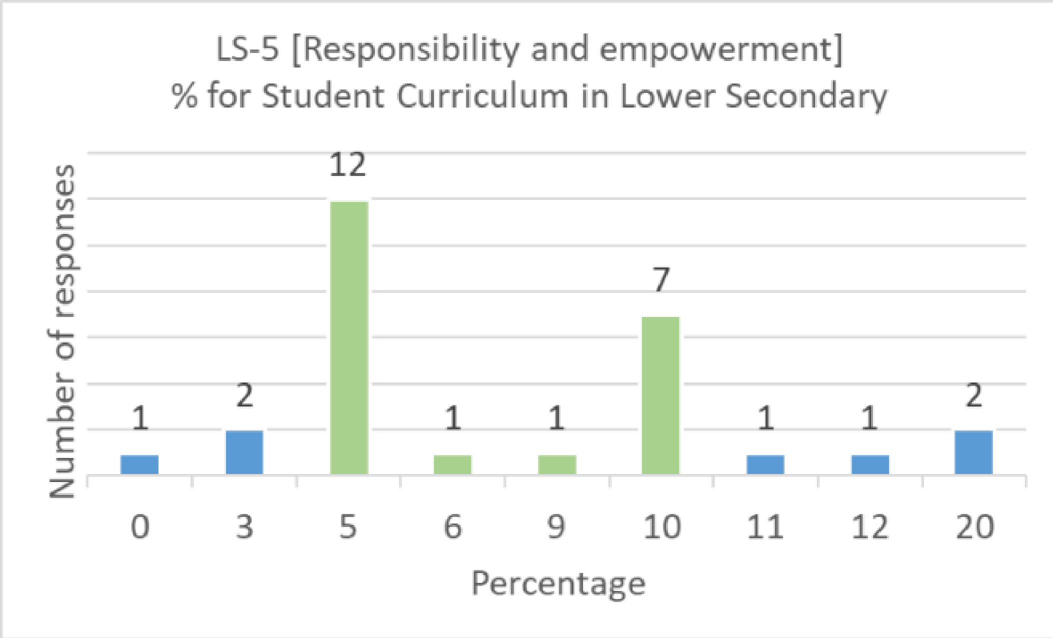

LS-5 [Human-computer interaction]
% for Student Curriculum in Lower Secondary
Number of responses
5
1
14
1
1
1
5
0
2
5
6
8
9
10
Percentage


LS-5 [Design and development]
% for Student Curriculum in Lower Secondary
Number of responses
4
1
8
2
11
1
1
0
1
5
9
10
15
20
Percentage


LS-5 [Digital creativity]
% for Student Curriculum in Lower Secondary
Number of responses
4
1
1
5
2
10
1
2
2
0
1
3
5
9
10
14
15
20
Percentage

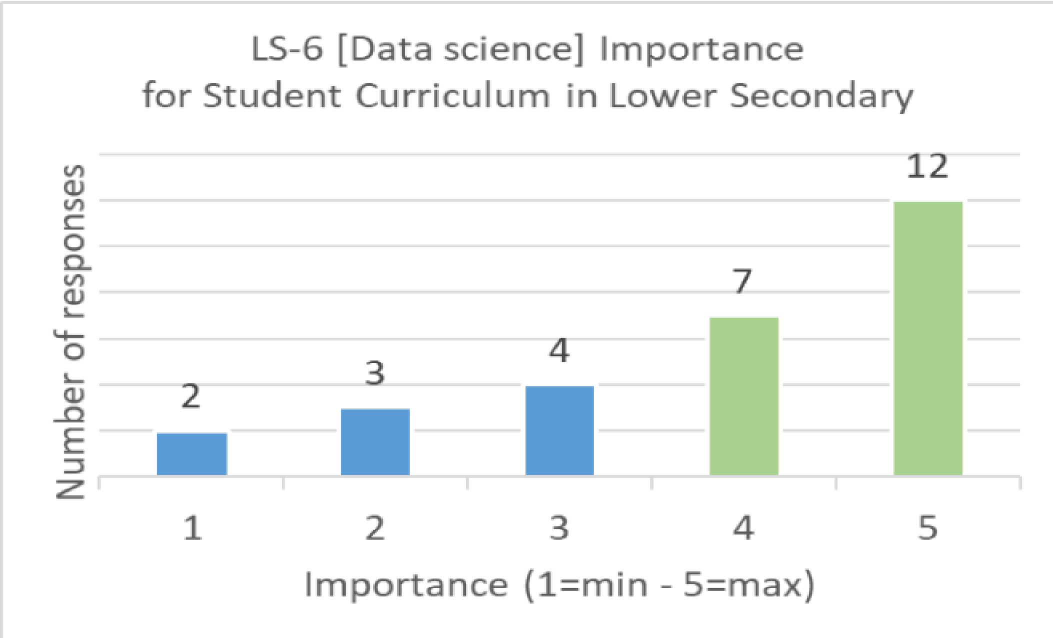

LS-5 [Modeling and simulation]
% for Student Curriculum in Lower Secondary
Number of responses
6
1
8
1
2
9
1
0
1
5
8
9
10
15
Percentage

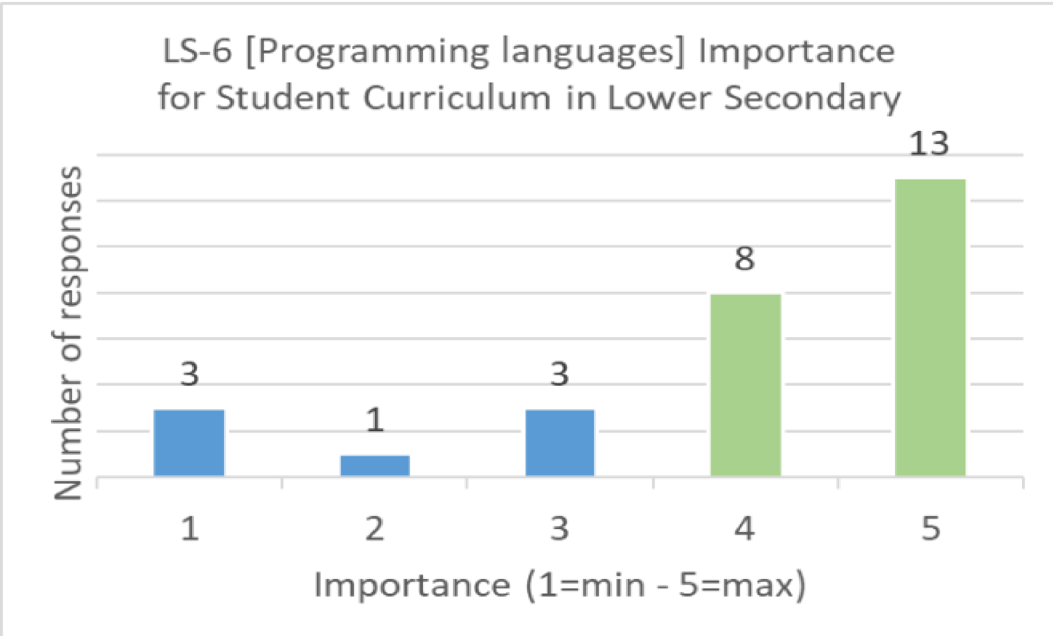

LS-5 [Privacy, safety and security]
% for Student Curriculum in Lower Secondary
Number of responses
2
1
6
1
2
12
1
2
1
0
3
5
6
9
10
12
15
20
Percentage

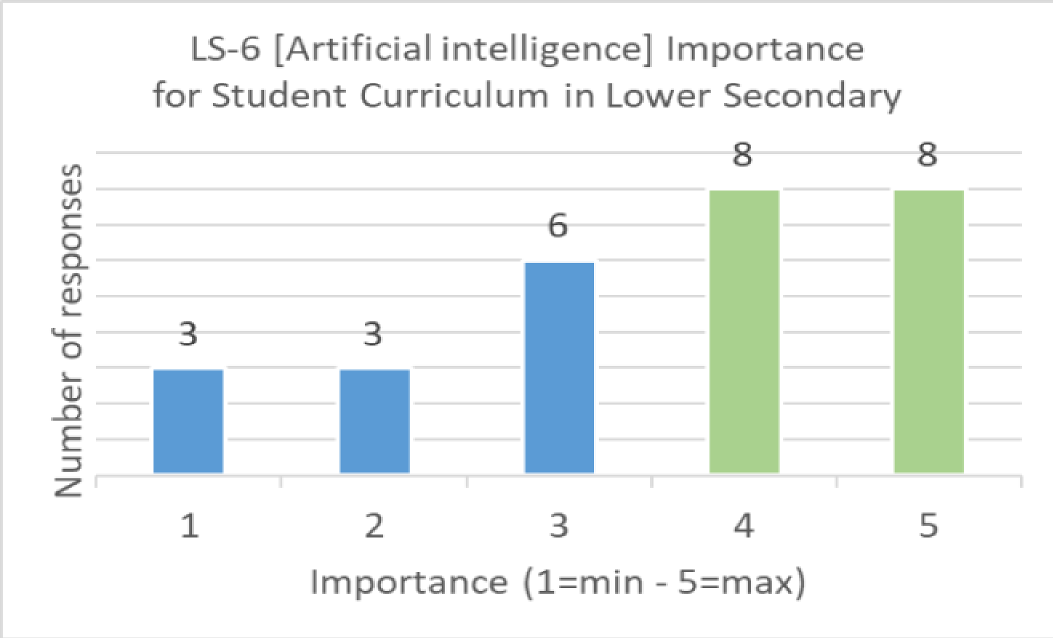

LS-5 [Responsibility and empowerment]
% for Student Curriculum in Lower Secondary
Number of responses
Percentage
0
3
5
6
9
10
11
12
20
1
2
12
1
1
7
1
1
2

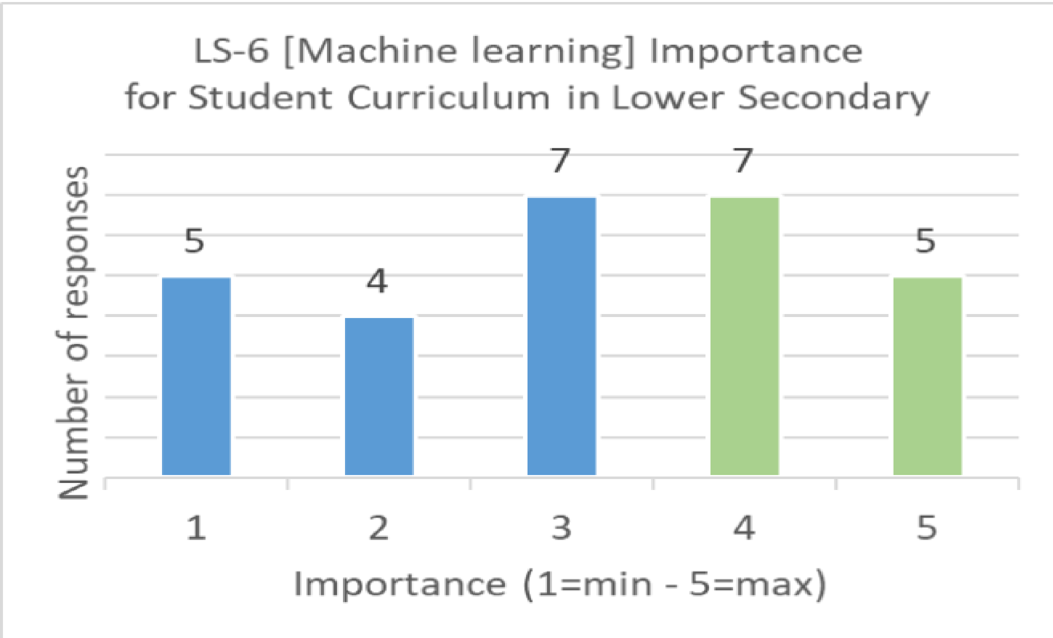
Lower Secondary School, student curriculum, contemporary topics

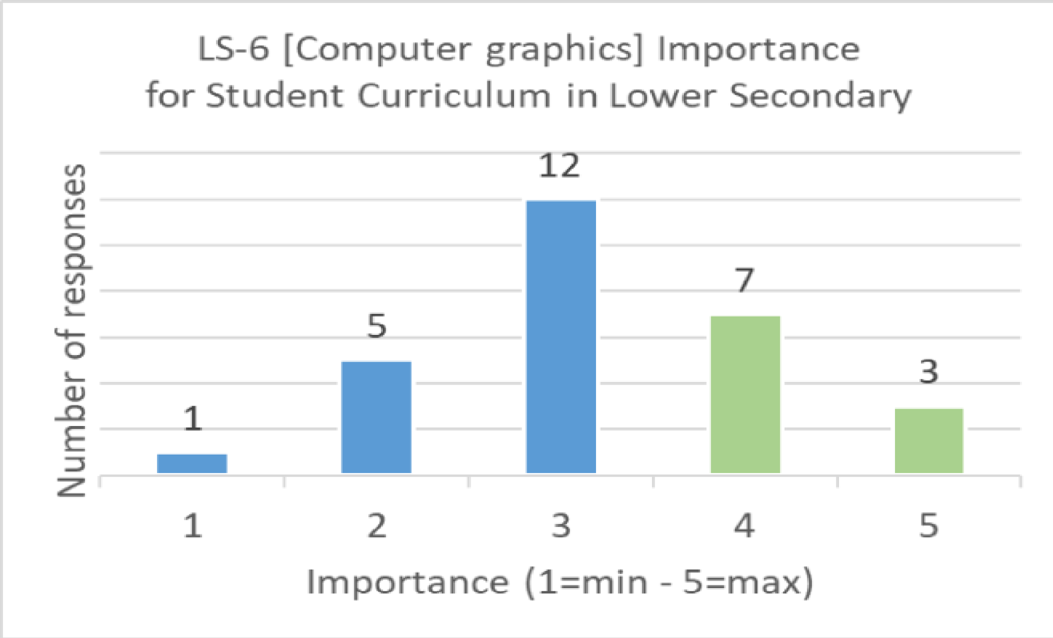
Importance in an ideal informatics curriculum of each of the [10 Contemporary Topics](#) described in the Informatics Reference Framework for School.

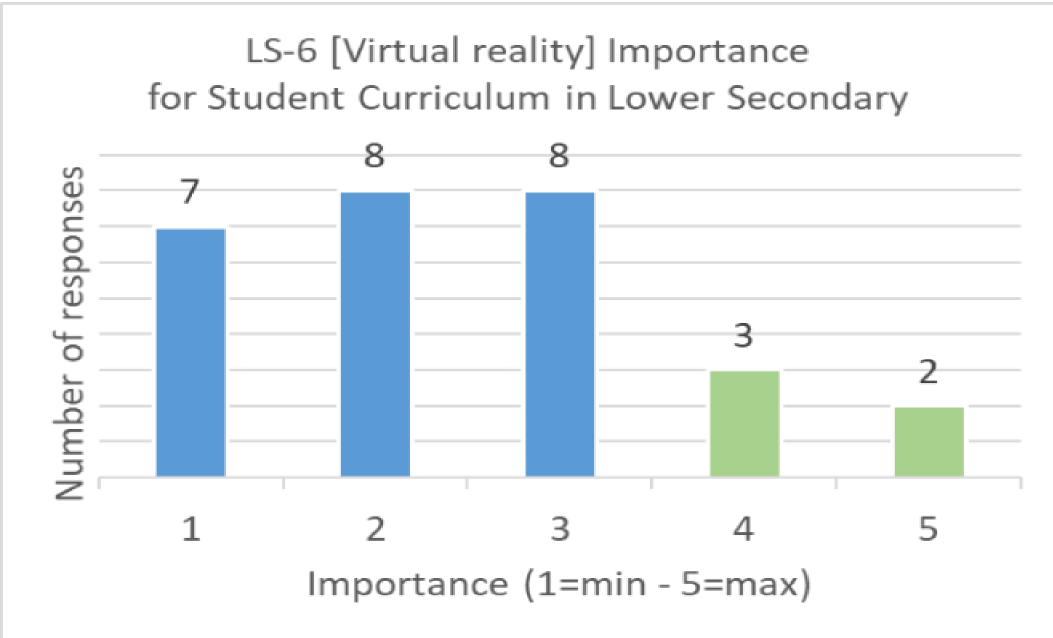


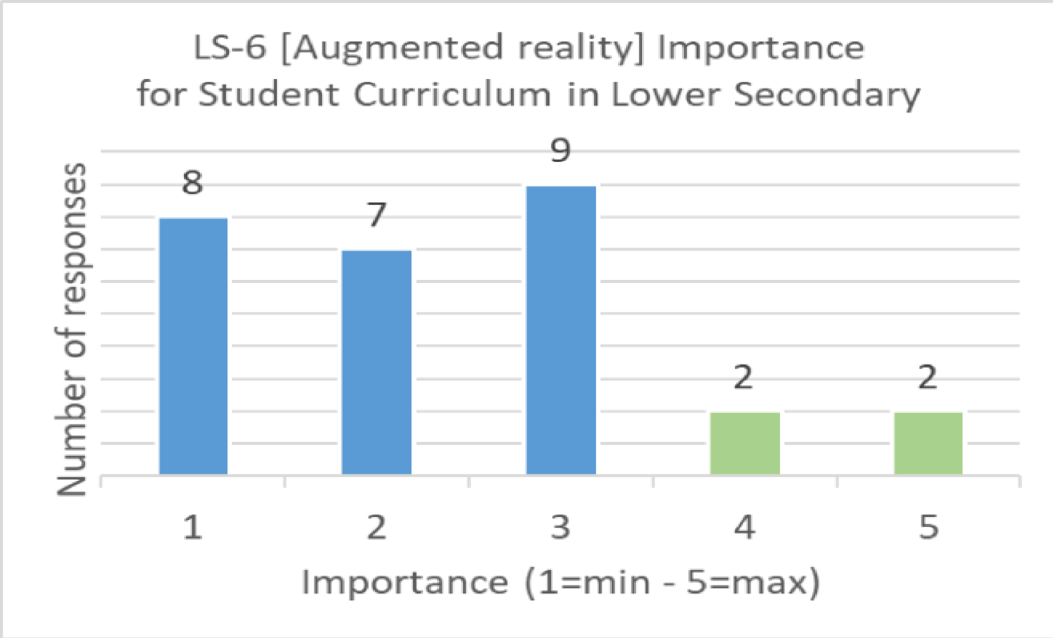


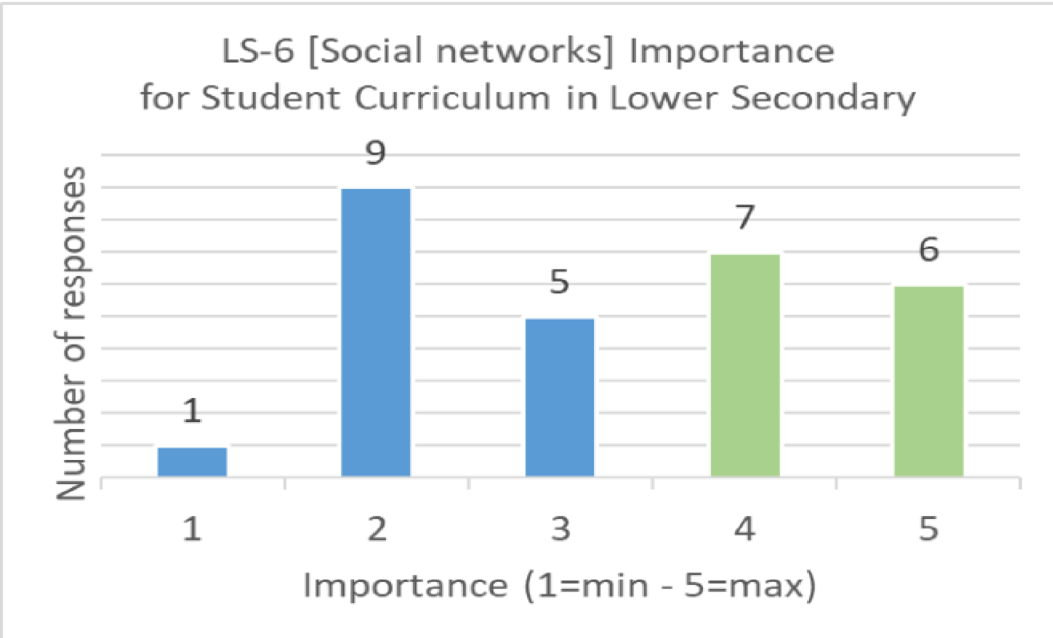

LS-6 [Artificial intelligence] Importance
for Student Curriculum in Lower Secondary
Number of responses
3
3
6
8
8
1
2
3
4
5
Importance (1=min - 5=max)

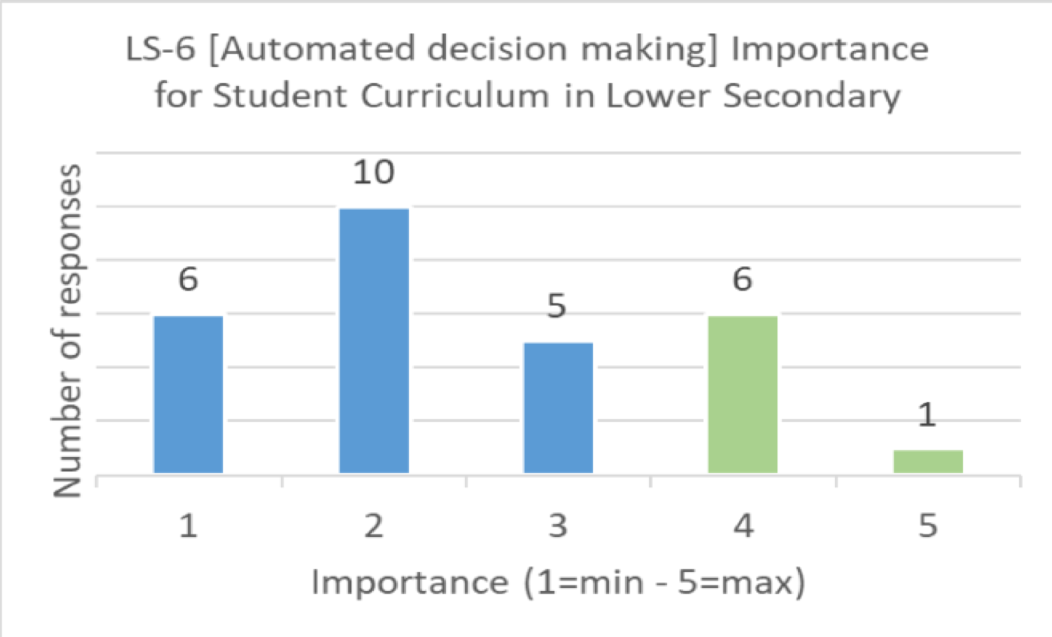

LS-6 [Machine learning] Importance
for Student Curriculum in Lower Secondary
Number of responses
5
4
7
7
5
1
2
3
4
5
Importance (1=min - 5=max)

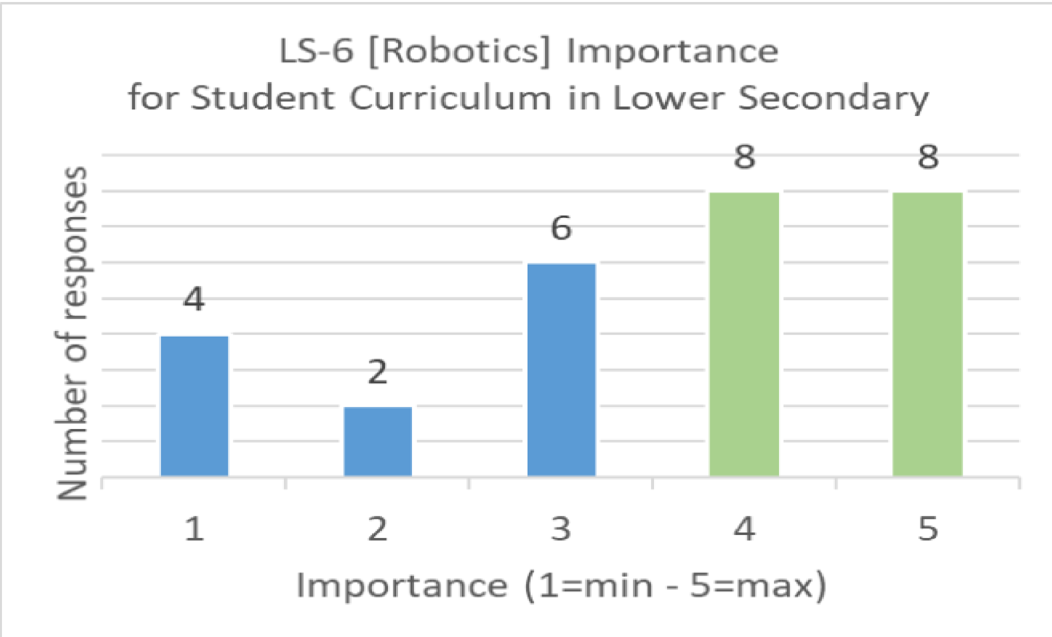

LS-6 [Computer graphics] Importance
for Student Curriculum in Lower Secondary
Number of responses
1
5
12
7
3
1
2
3
4
5
Importance (1=min - 5=max)


LS-6 [Virtual reality] Importance
for Student Curriculum in Lower Secondary
Number of responses
7
8
8
3
2
1
2
3
4
5
Importance (1=min - 5=max)


LS-6 [Augmented reality] Importance
for Student Curriculum in Lower Secondary
Number of responses
8
7
9
2
2
1
2
3
4
5
Importance (1=min - 5=max)

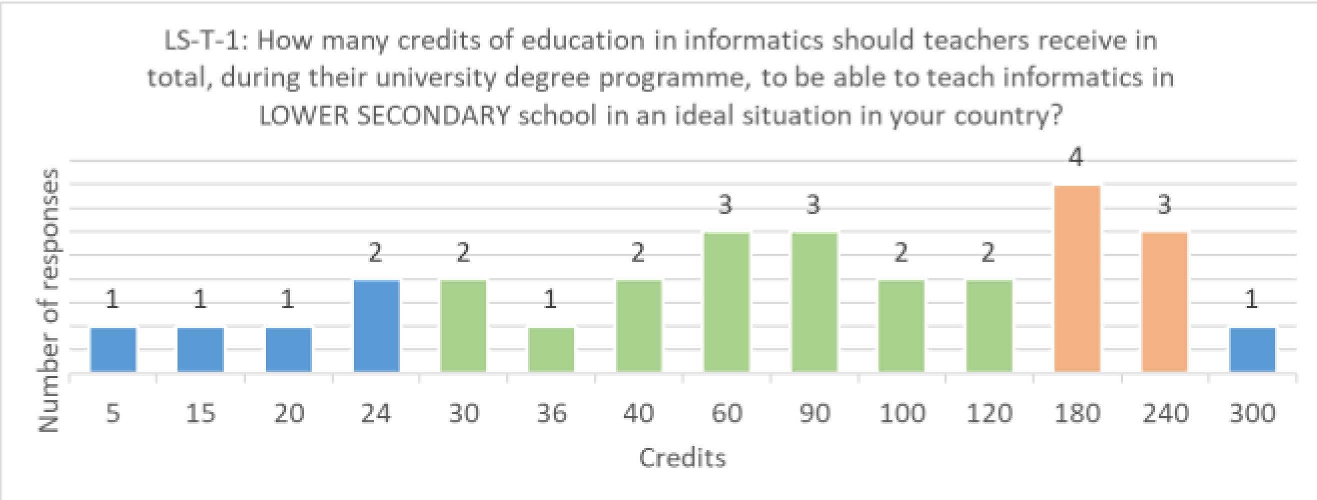

LS-6 [Social networks] Importance
for Student Curriculum in Lower Secondary
Number of responses
1
9
5
7
6
1
2
3
4
5
Importance (1=min - 5=max)


LS-6 [Automated decision making] Importance
for Student Curriculum in Lower Secondary
Number of responses
6
10
5
6
1
1
2
3
4
5
Importance (1=min - 5=max)


LS-6 [Robotics] Importance
for Student Curriculum in Lower Secondary
Number of responses
4
2
6
8
8
1
2
3
4
5
Importance (1=min - 5=max)

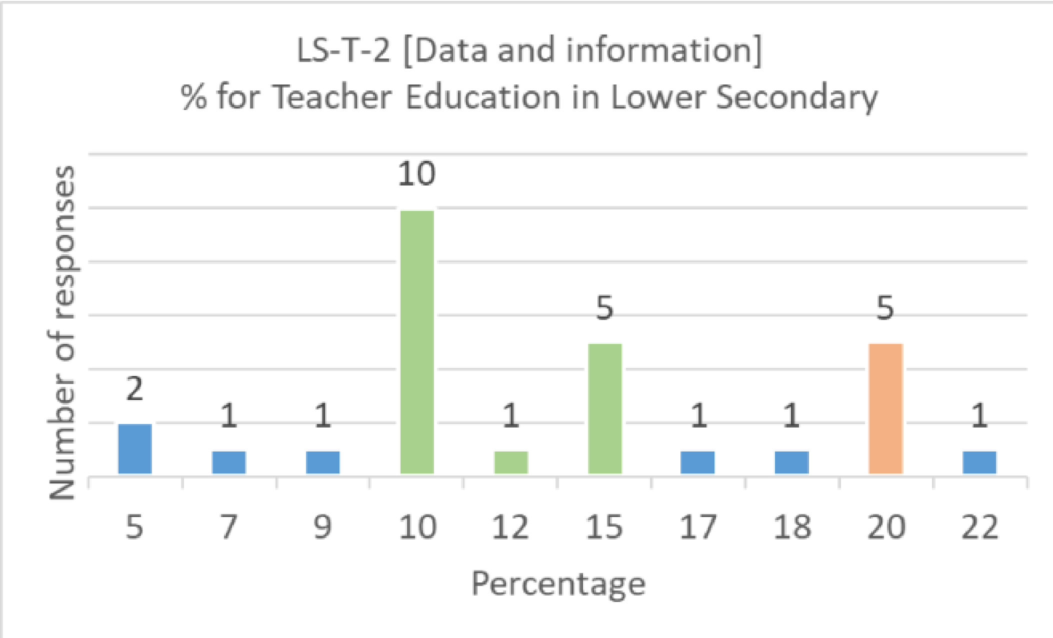
Lower Secondary School, teacher education, general question

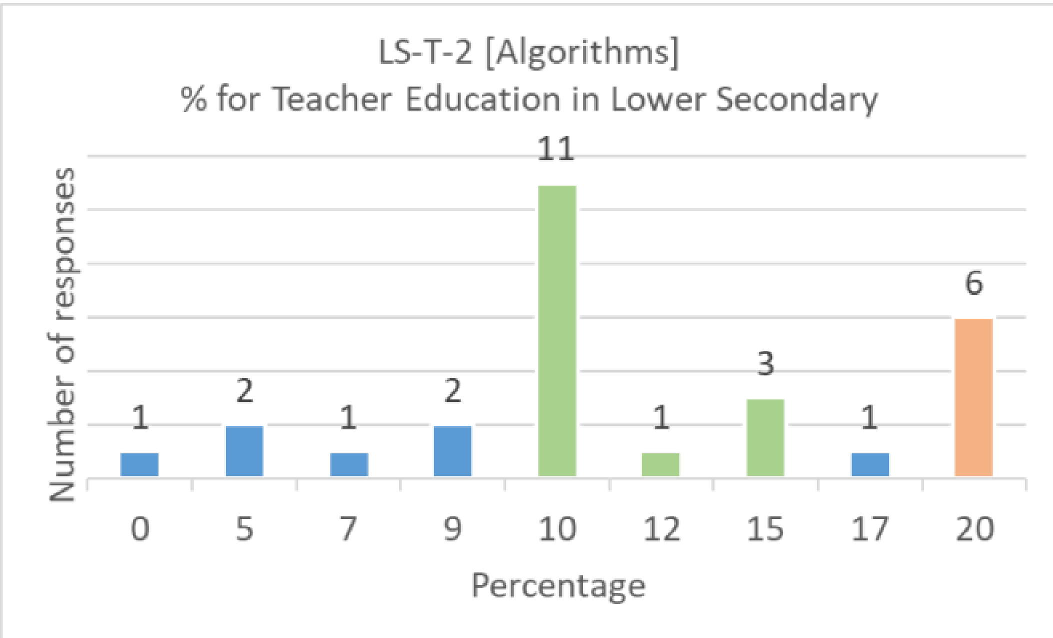
How many credits of education in informatics should **teachers** receive in total, during their university degree programme, to be able to teach informatics in **lower secondary school** in an ideal situation in your country?

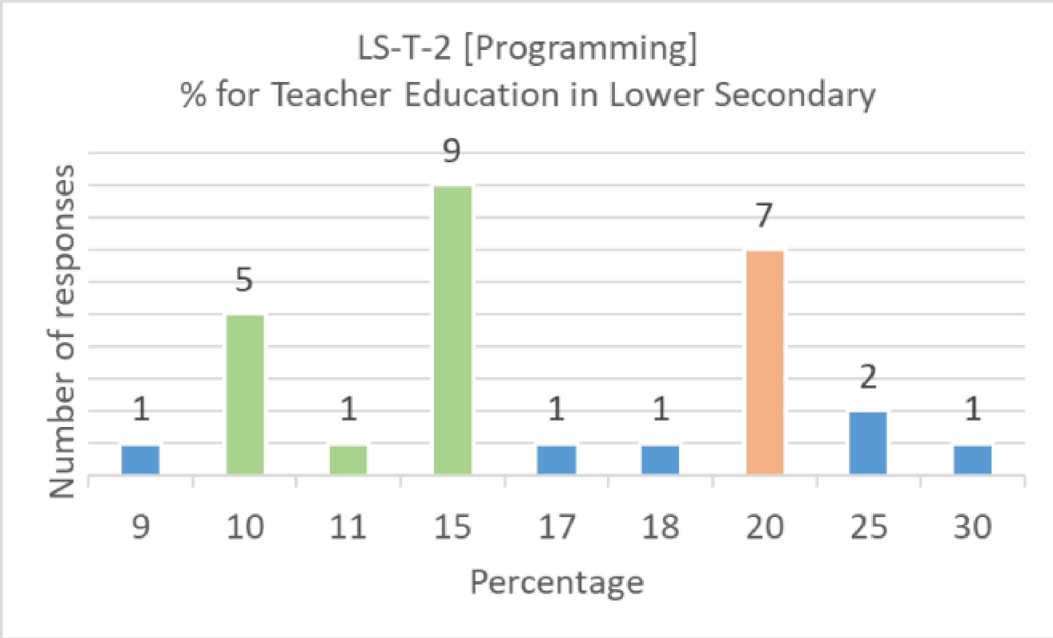


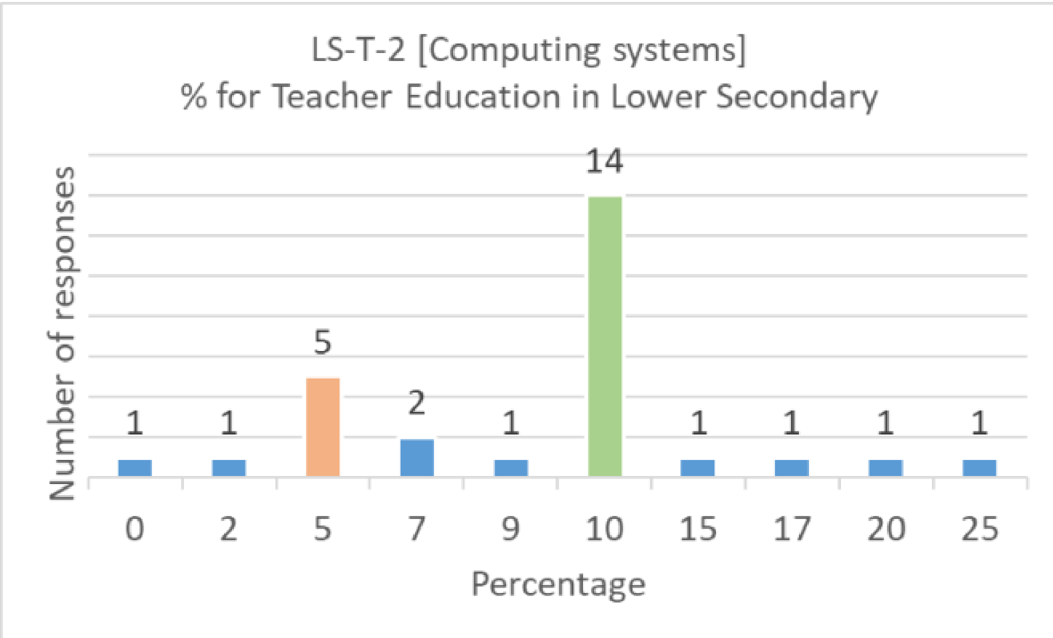
Lower Secondary School, teacher education, core topic areas

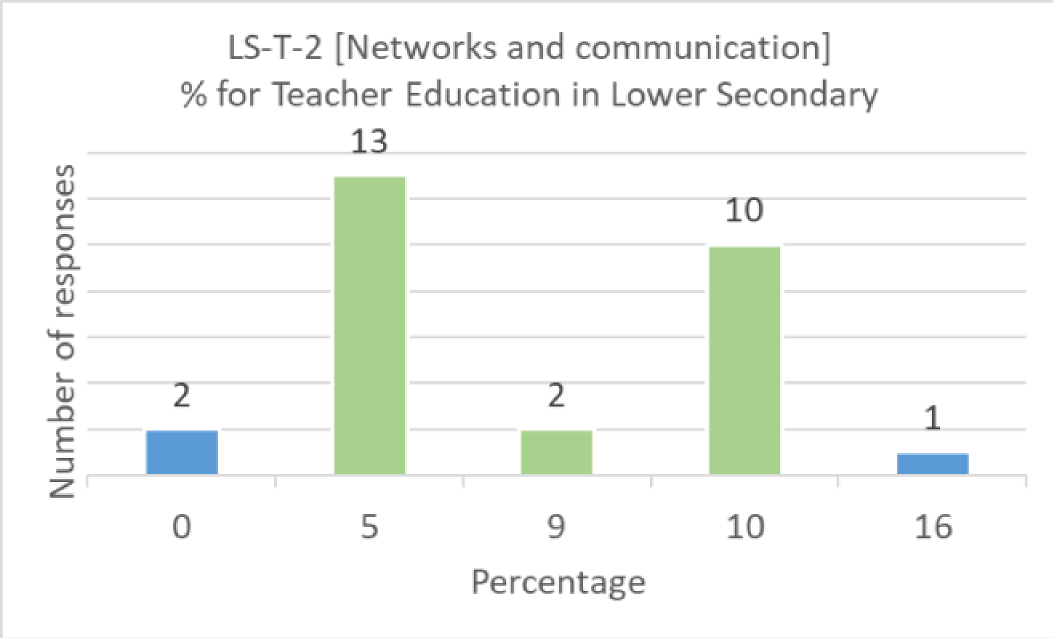
Percentage of informatics curriculum time for teacher education ideally allocated to each of the 11 Core Topic Areas described in the Informatics Reference Framework for School.

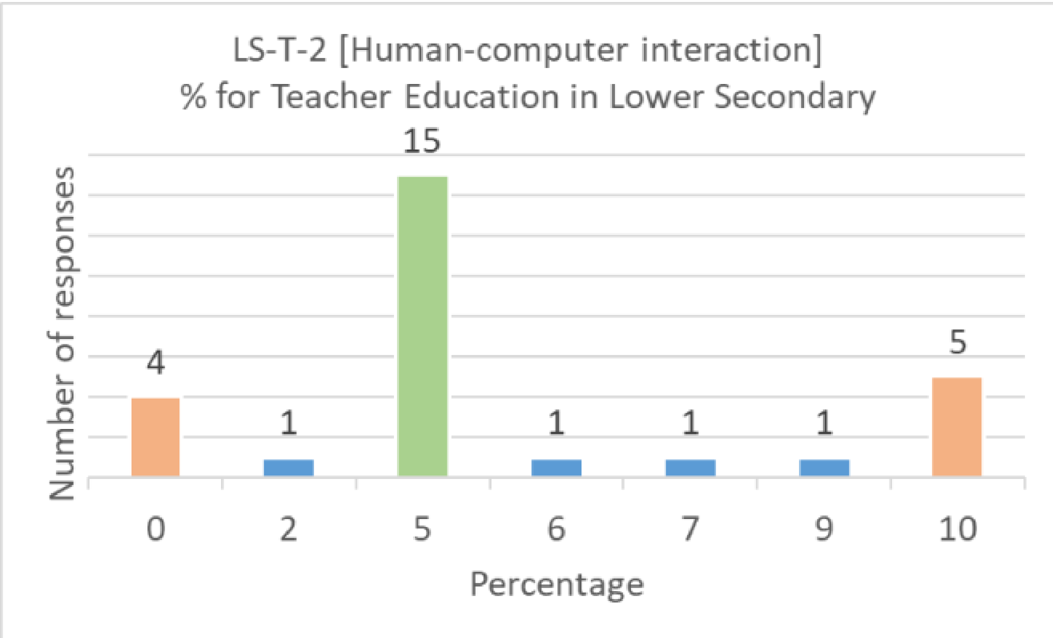


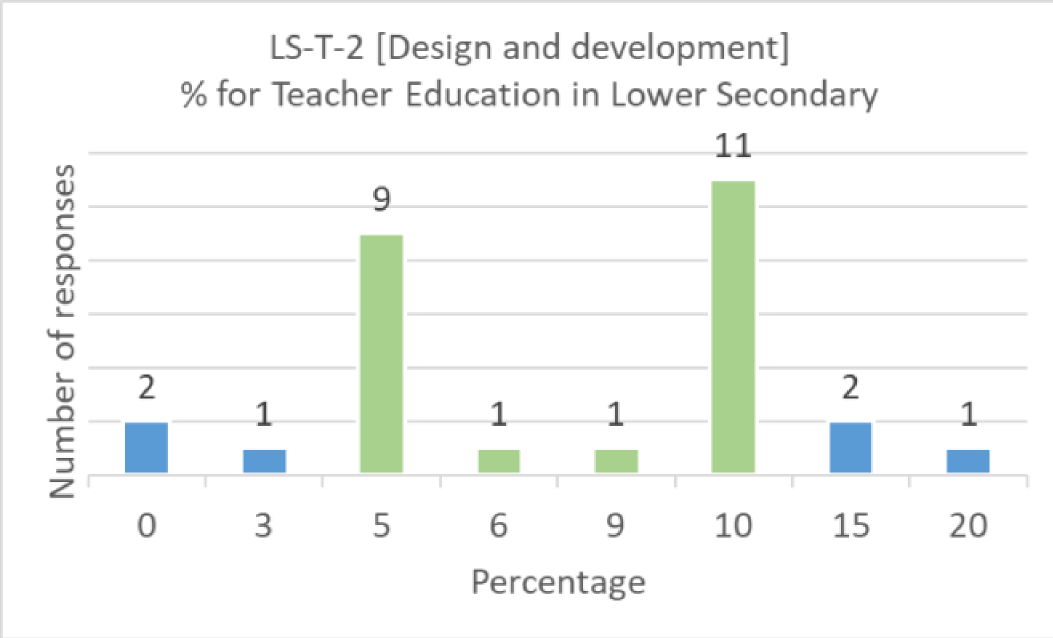


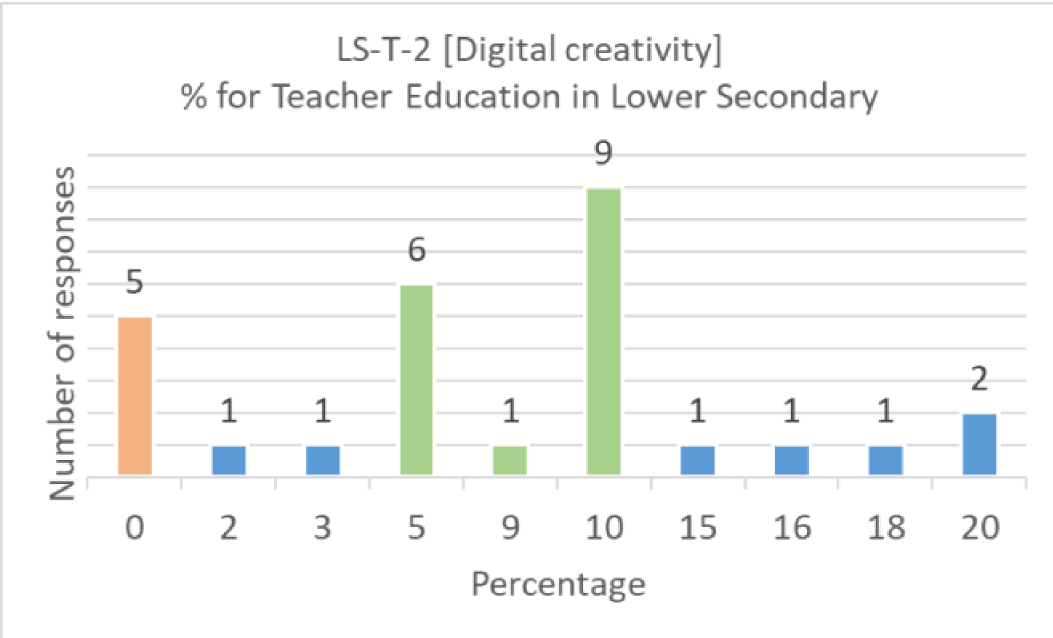

LS-T-2 [Programming]
% for Teacher Education in Lower Secondary
Number of responses
Percentage
9
10
11
15
17
18
20
25
30
1
5
1
9
1
1
7
2
1

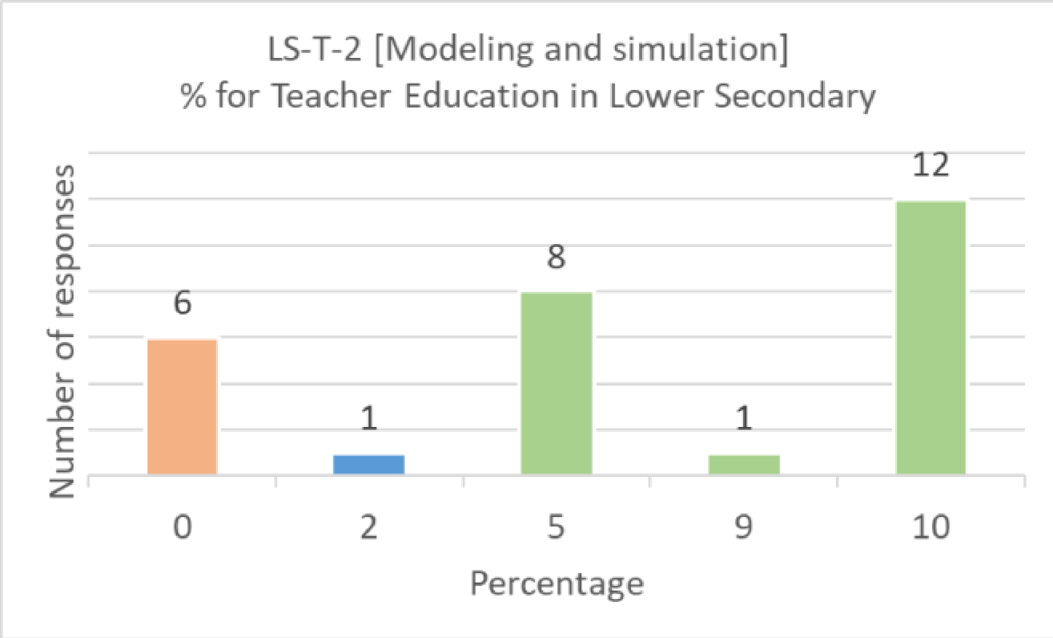

LS-T-2 [Computing systems]
% for Teacher Education in Lower Secondary
Number of responses
Percentage
0
2
5
7
9
10
15
17
20
25
1
1
5
2
1
14
1
1
1
1

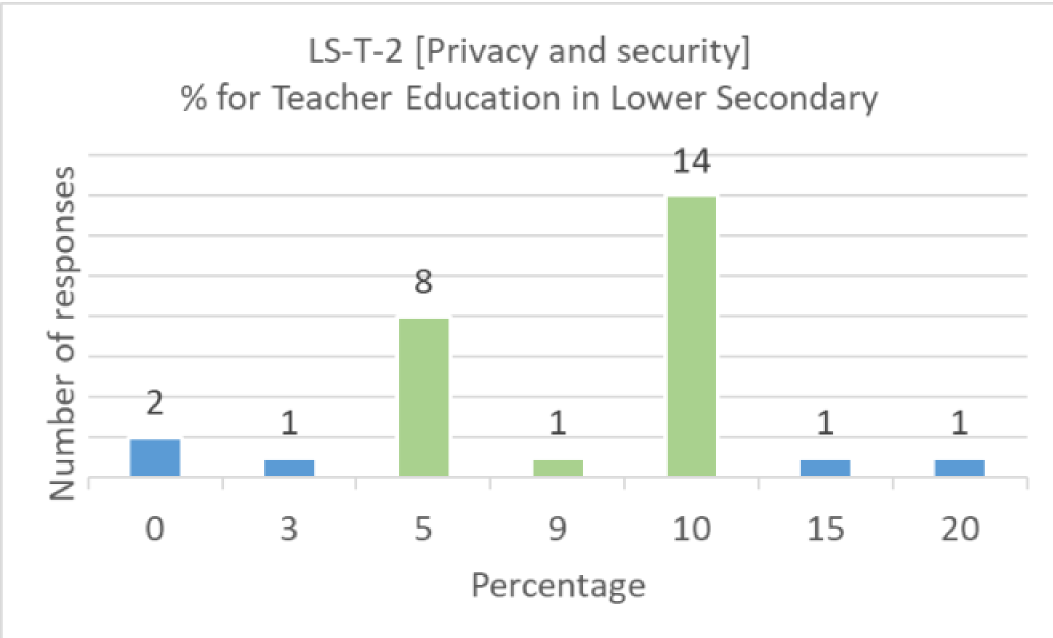

LS-T-2 [Networks and communication]
% for Teacher Education in Lower Secondary
Number of responses
Percentage
2
13
2
10
1
0
5
9
10
16

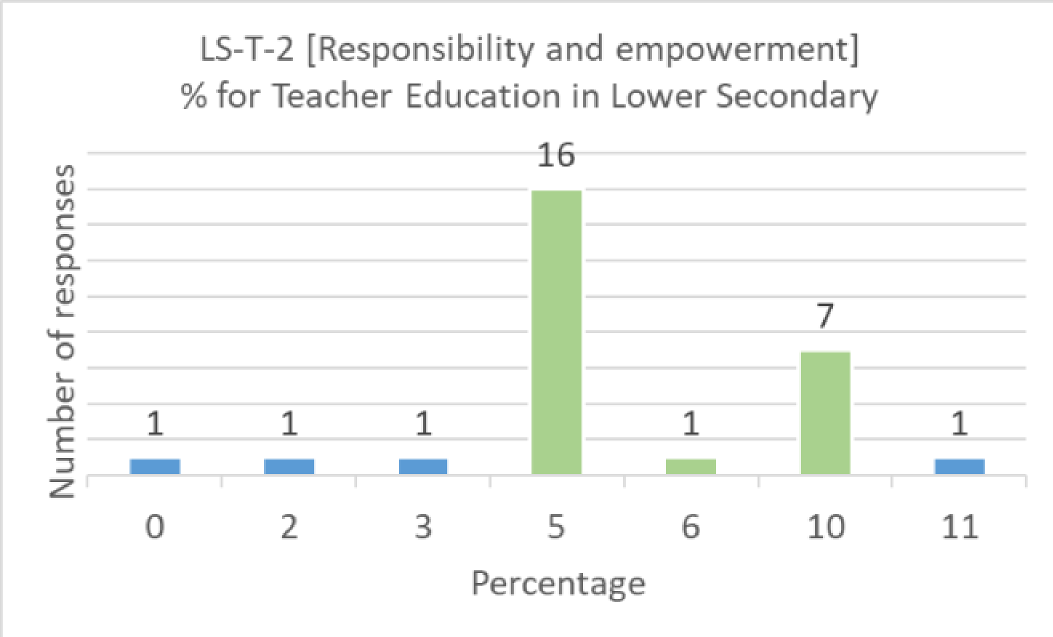

LS-T-2 [Human-computer interaction]
% for Teacher Education in Lower Secondary
Number of responses
Percentage
4
1
15
1
1
1
5
0
2
5
6
7
9
10


LS-T-2 [Design and development]
% for Teacher Education in Lower Secondary
Number of responses
2
1
9
1
1
11
2
1
0
3
5
6
9
10
15
20
Percentage


LS-T-2 [Digital creativity]
% for Teacher Education in Lower Secondary
Number of responses
5
1
1
6
1
9
1
1
1
2
0
2
3
5
9
10
15
16
18
20
Percentage

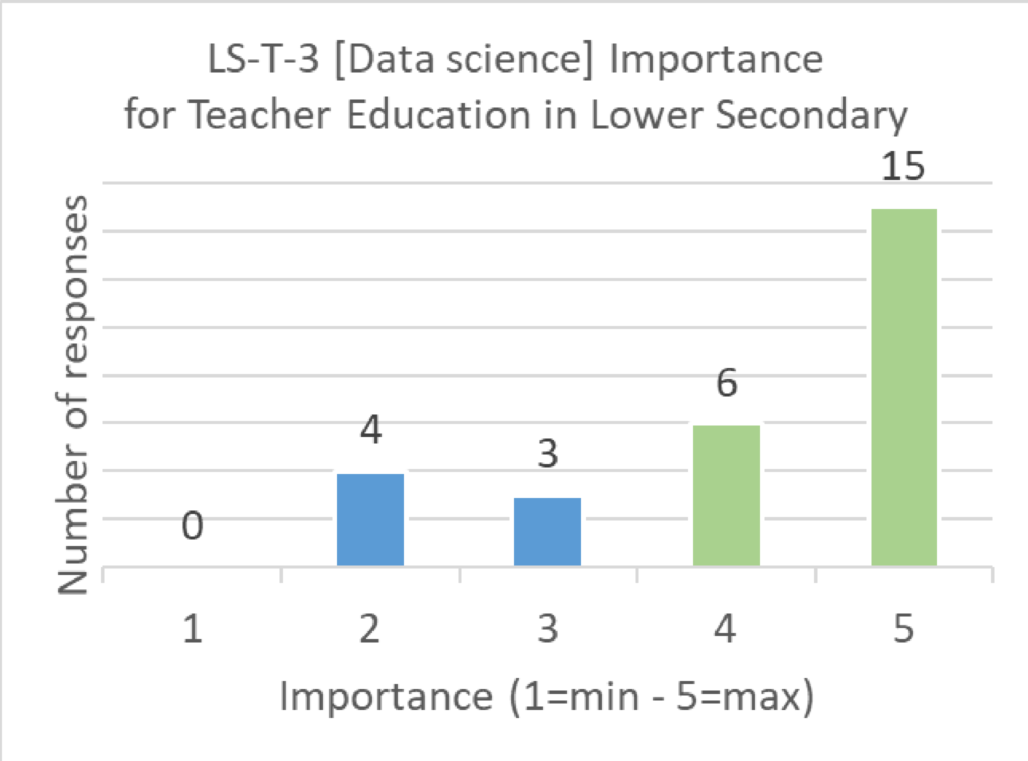

LS-T-2 [Modeling and simulation]
% for Teacher Education in Lower Secondary
Number of responses
6
1
8
1
12
0
2
5
9
10
Percentage

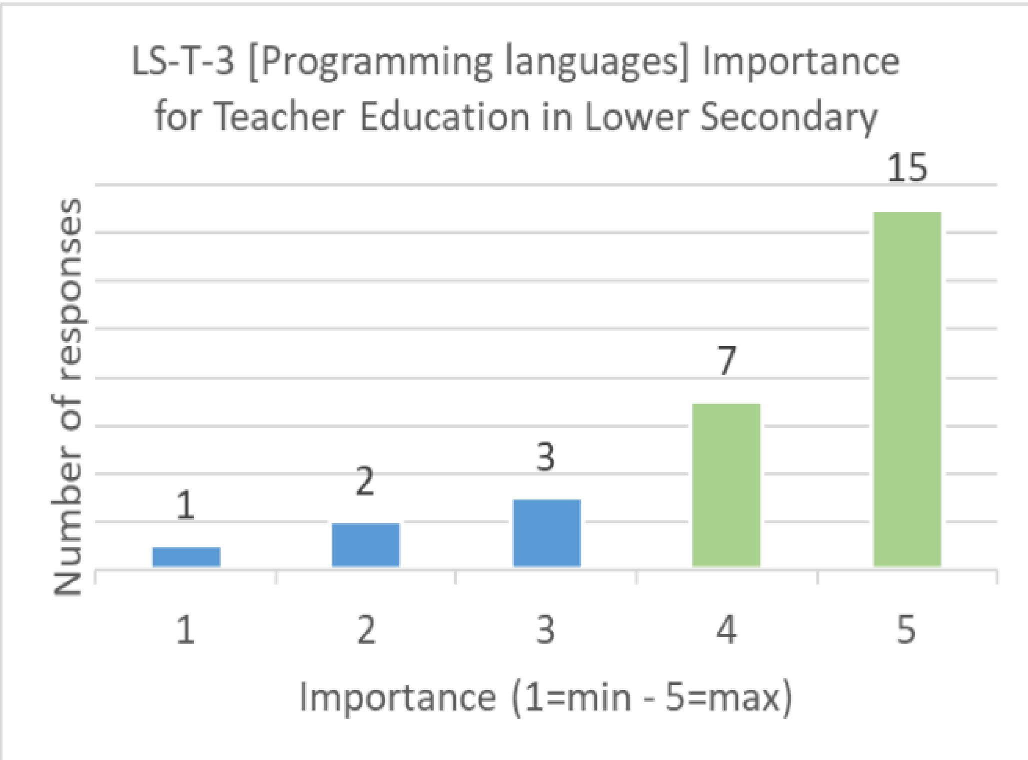

LS-T-2 [Privacy and security]
% for Teacher Education in Lower Secondary
Number of responses
2
1
8
1
14
1
1
0
3
5
9
10
15
20
Percentage

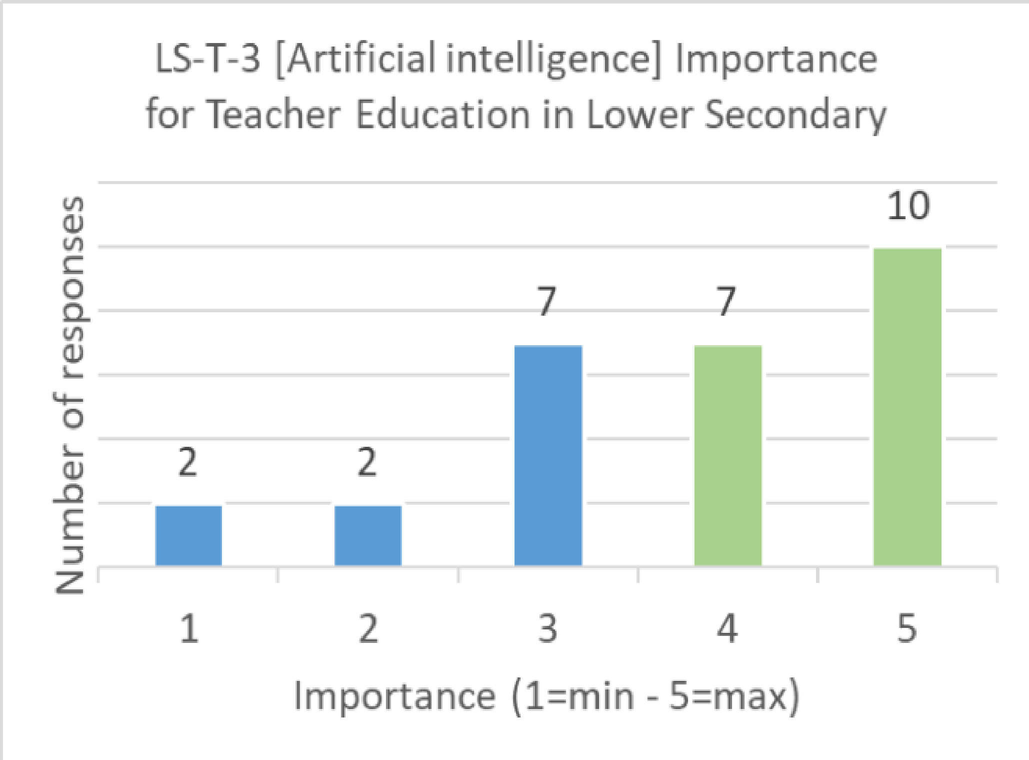

LS-T-2 [Responsibility and empowerment]
% for Teacher Education in Lower Secondary
Number of responses
1
1
1
16
1
7
1
0
2
3
5
6
10
11
Percentage

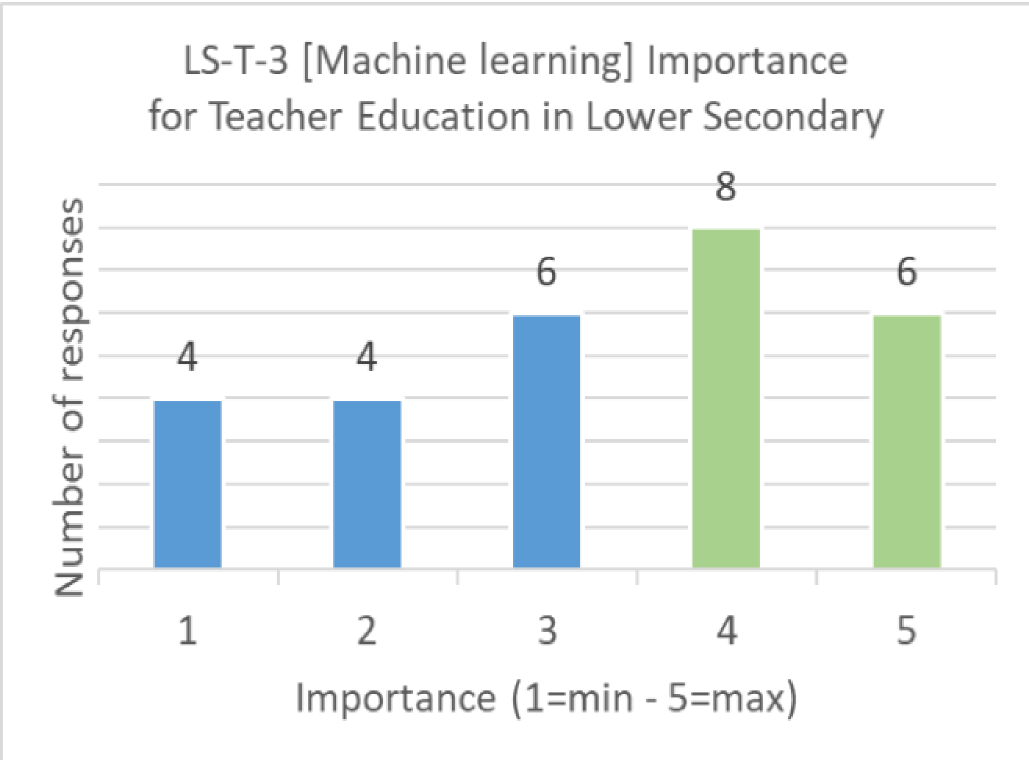
Lower Secondary School, teacher education, contemporary topics

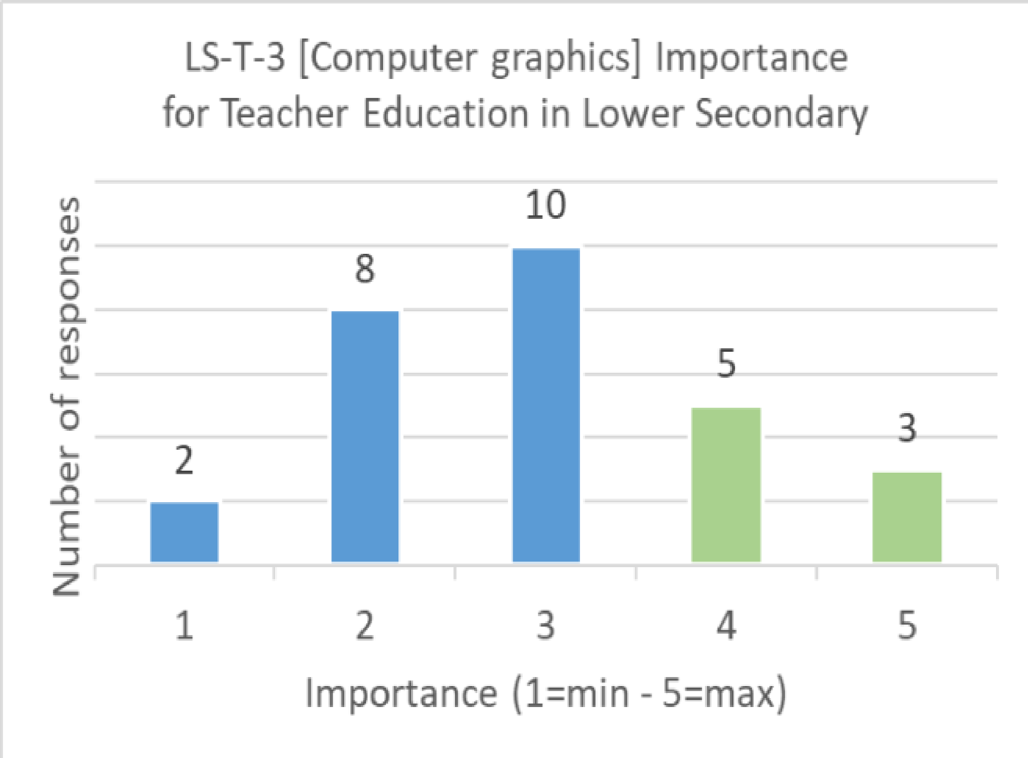
Importance in an ideal informatics curriculum for teacher education of each of the 10 Contemporary Topics described in the Informatics Reference Framework for School.

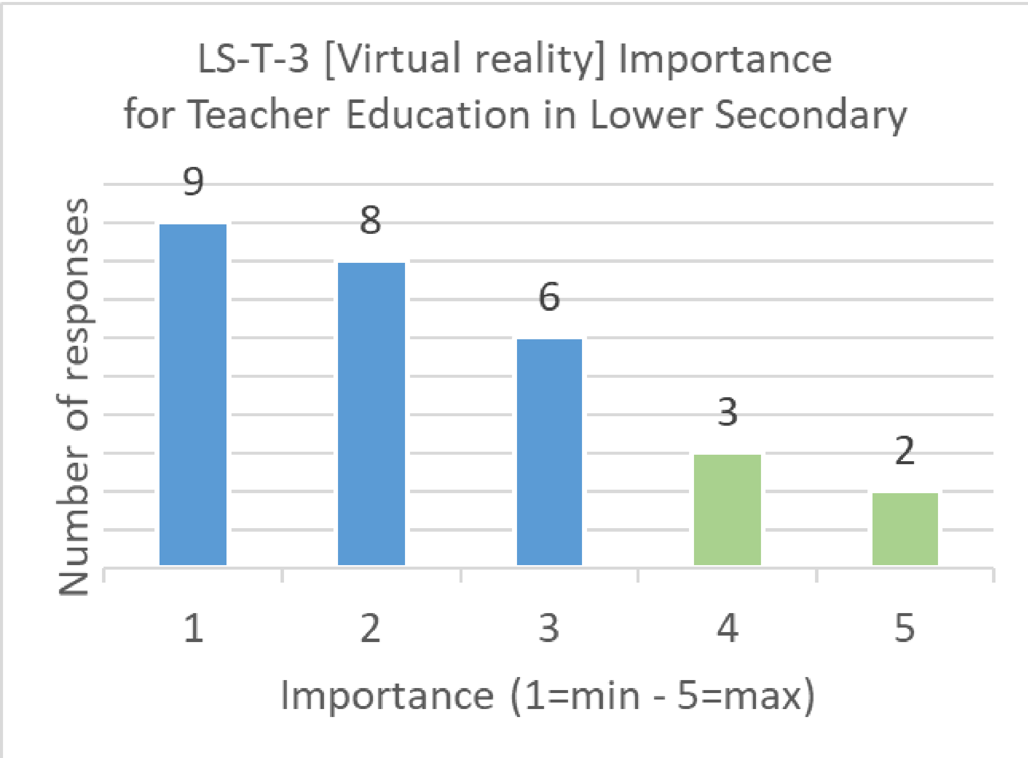


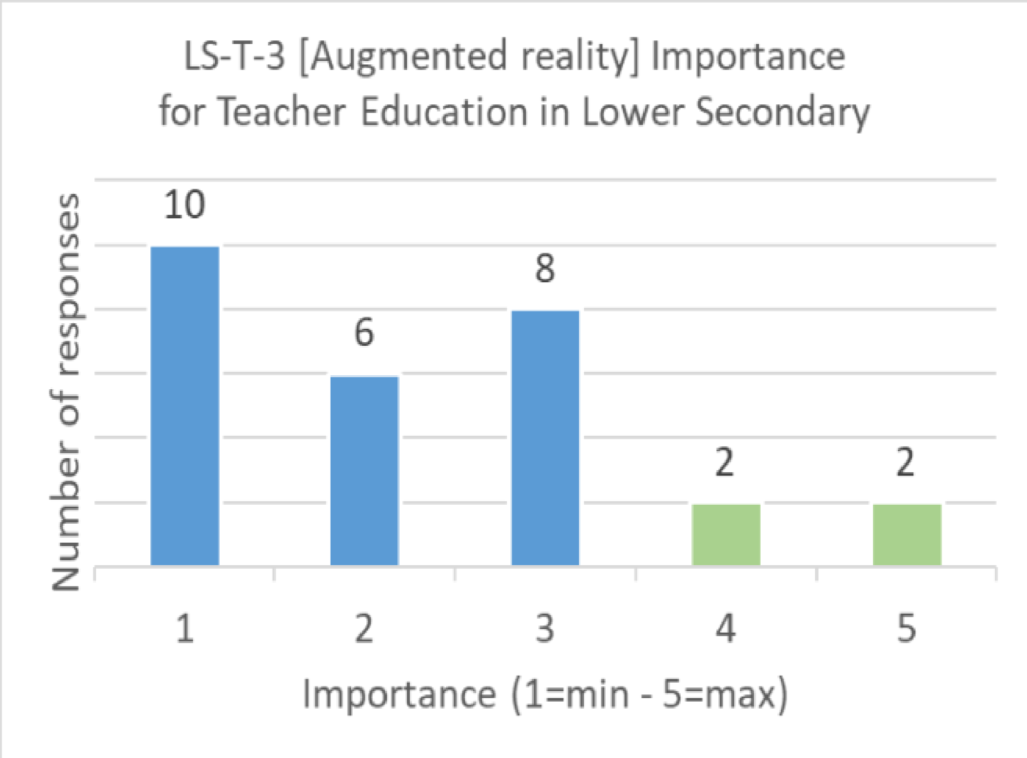


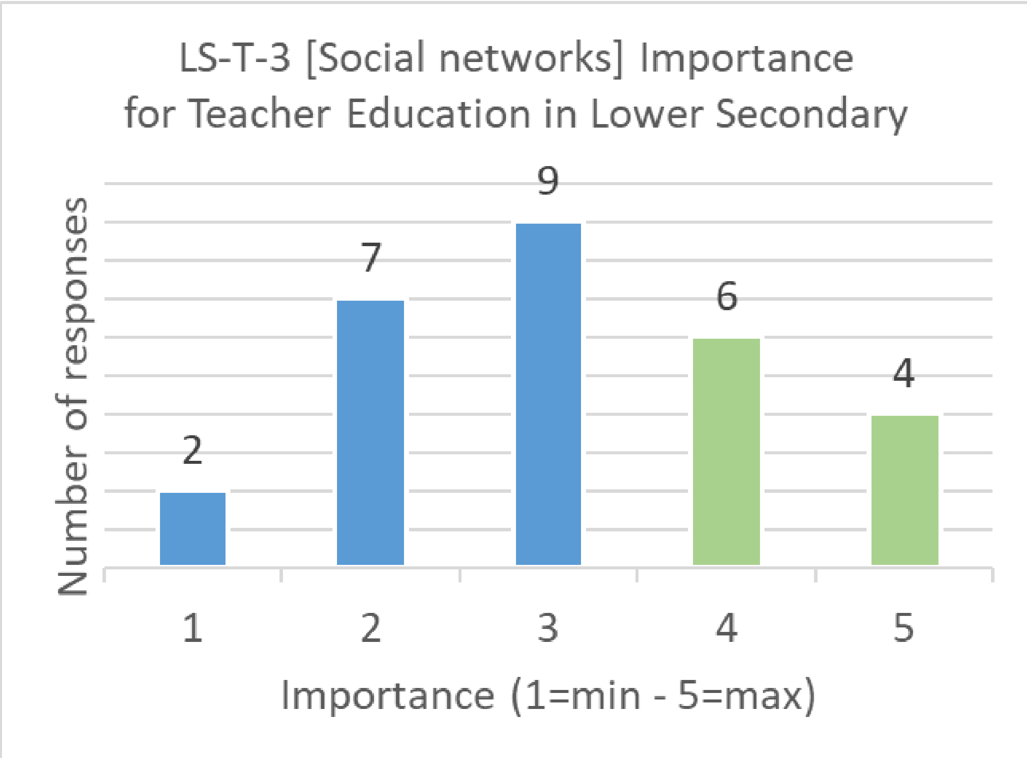

LS-T-3 [Artificial intelligence] Importance for Teacher Education in Lower Secondary
Number of responses
2
2
7
7
10
1
2
3
4
5
Importance (1=min - 5=max)

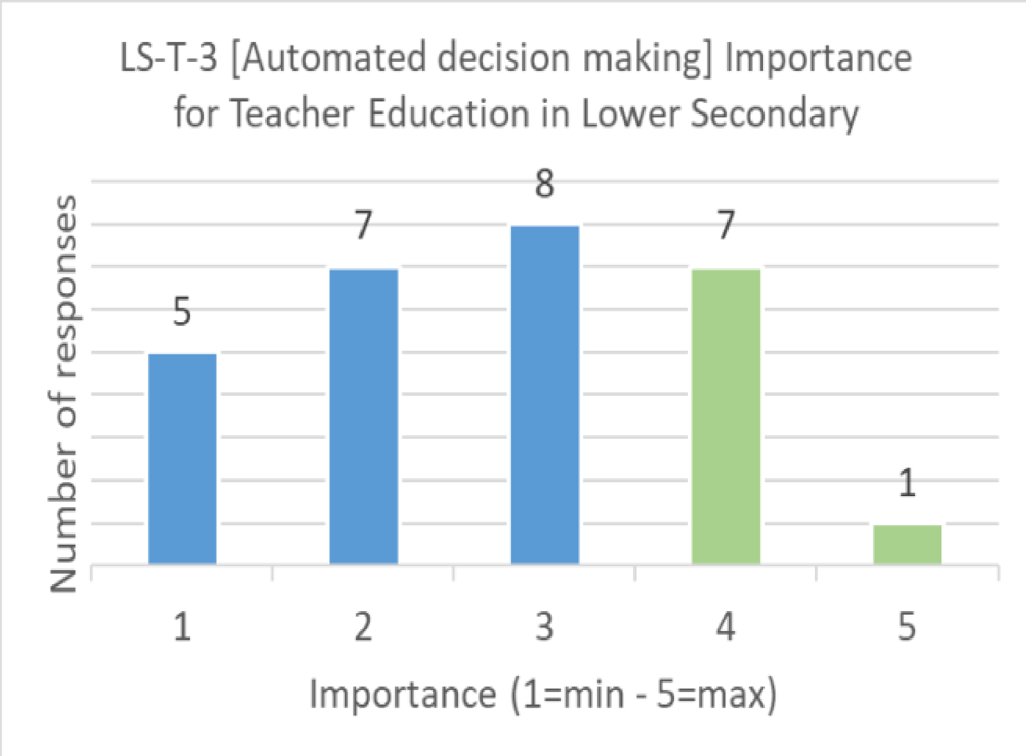

LS-T-3 [Machine learning] Importance for Teacher Education in Lower Secondary
Number of responses
4
4
6
8
6
1
2
3
4
5
Importance (1=min - 5=max)

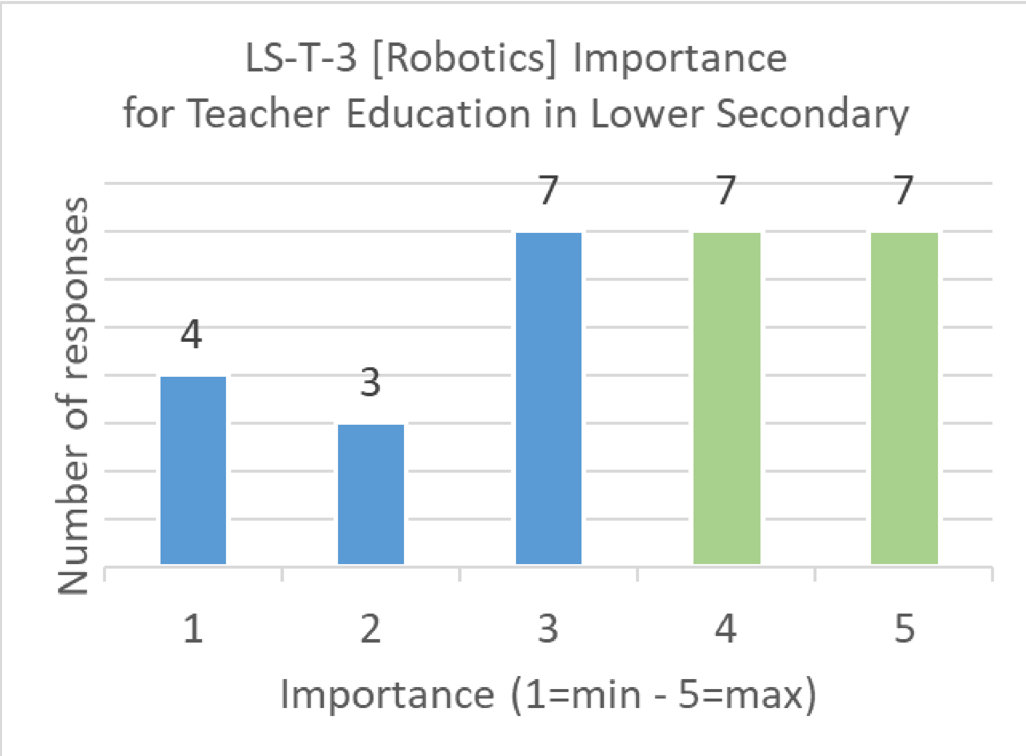

LS-T-3 [Computer graphics] Importance
for Teacher Education in Lower Secondary
Number of responses
2
8
10
5
3
1
2
3
4
5
Importance (1=min - 5=max)


LS-T-3 [Virtual reality] Importance
for Teacher Education in Lower Secondary
Number of responses
9
8
6
3
2
1
2
3
4
5
Importance (1=min - 5=max)


LS-T-3 [Augmented reality] Importance
for Teacher Education in Lower Secondary
Number of responses
10
6
8
2
2
1
2
3
4
5
Importance (1=min - 5=max)


LS-T-3 [Social networks] Importance
for Teacher Education in Lower Secondary
Number of responses
2
7
9
6
4
1
2
3
4
5
Importance (1=min - 5=max)


LS-T-3 [Automated decision making] Importance
for Teacher Education in Lower Secondary
Number of responses
5
7
8
7
1
1
2
3
4
5
Importance (1=min - 5=max)


LS-T-3 [Robotics] Importance
for Teacher Education in Lower Secondary
Number of responses
4
3
7
7
7
1
2
3
4
5
Importance (1=min - 5=max)

The Informatics for All coalition

Informatics for All is a coalition whose aim is to establish informatics as a fundamental discipline to be taken by all students in school. Informatics should be seen as important as mathematics, the sciences, and the various languages. It should be recognized by all as a truly foundational discipline that plays a significant role in education for the 21st century.

It is currently made up by the following organisations:

The ACM Europe Council aims to increase the level and visibility of Association for Computing Machinery (ACM) activities across Europe. The Council comprises European computer scientists committed to fostering the visibility and relevance of ACM in Europe and is focused on a wide range of European ACM activities, including organizing and hosting high-quality ACM conferences, expanding ACM chapters, improving computer science education, and encouraging greater participation of Europeans in all dimensions of ACM.

CEPIS is the representative body of national informatics associations throughout greater Europe. Established in 1989 by nine European informatics societies, CEPIS has since grown to represent over 450,000 ICT and informatics professionals in 29 countries. CEPIS promotes the development of the information society in Europe. Its main area of focus is the promotion and development of IT skills across Europe. CEPIS is responsible for the highly successful ECDL programme and produces a range of research and publications in the area of skills.

Informatics Europe represents the academic and research community in informatics in Europe. Bringing together university departments and research laboratories, it creates a strong common voice to safeguard and shape quality research and education in informatics in Europe. With over 160 member institutions across 33 countries, Informatics Europe promotes common positions and acts on common priorities in the areas of education, research, knowledge transfer and social impact of informatics.

IFIP was founded in 1960 under the auspices of UNESCO, as a federation for societies working in information processing. IFIP's aim is two-fold: to support information processing in the countries of its members and to encourage technology transfer to developing nations. As its mission statement states: IFIP is the global non-profit federation of societies of ICT professionals that aims at achieving a worldwide professional and socially responsible development and application of information and communication technologies.