"Are the Insides of a Smartphone Different from a Desktop?": Study about Preconceptions of 6th and 8th Graders Comparing Hardware Components

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Abstract. This study investigates sixth and eighth graders' understanding of the differences and similarities between smartphone and desktop hardware components. Through semi-structured online interviews with 49 students, the research reveals that children most often compared the number or size of components in the devices, or noted that both types of devices have some components (e.g., *memory*) but not others (e.g., *fan*). Additionally, eighth graders, compared to sixth graders, tended to possess more scientifically accurate views, particularly in recognising key components like processors in both smartphones and desktops and were more likely to be aware of invisible components (e.g., *processor*). These findings underscore the importance of tailoring educational materials to address these preconceptions. Future work will focus on developing educational resources that deepen students' understanding of desktop architecture and components, guiding them from intuitive notions to scientifically grounded knowledge.

Keywords: Computer Science · Education · Lower secondary school · Conceptions · Hardware · Hardware components

1 Introduction

Teaching about hardware, computer components, and the internals of computers remains important, as emphasised in current curriculum documents (e.g., [3]). This knowledge is also practical for everyday life—most of us have had to purchase new electronics (e.g., a smartphone) or troubleshoot a malfunctioning device. To effectively teach this topic, quality educational materials are essential. However, current materials are often not evidence-based. It is well understood that such materials must build on children's preconceptions to help them develop concepts that align with current scientific knowledge [4]. Research shows that children's understanding of digital technologies is typically intuitive and fragmented, shaped by everyday experiences (e.g., [5]). Furthermore, a deep,

conceptual grasp of underlying principles is rare, even among adolescents (e.g., [2]).

A key idea in computer hardware education is recognising that similar components with similar purposes exist across different digital devices. While some research has explored children's preconceptions about desktop computer components (e.g., [6], [5]), the comparative aspect regarding other devices is less frequently studied (e.g., [1], [6]). This study investigates sixth and eighth graders' understanding of the similarities and differences between smartphone and desktop computer internal components. We are not concerned with normative correctness, as every preconception can be valuable for developing effective teaching materials [4].

We chose this age group because adolescents are generally familiar with both desktop computers and mobile devices [2] and should recognise some differences and similarities.

2 Method

This study was part of a larger mixed-methods project. As part of this project, children participated in 45-minute semi-structured online interviews conducted via Zoom, during which they answered the following question on comparing desktop computers and cell phones: "How does the inside of a computer differ from the inside of a smartphone?". This question was followed by additional follow-up questions, when relevant. This poster presents findings specifically from this segment of the interviews.

The study involved 25 sixth-graders (around 12 years old, 13 girls) and 24 eighth-graders (around 14 years old, 12 girls), all of whom had minimal prior exposure to computer science topics in school. Participants were recruited from various regions across Czechia through Facebook and a network of teachers to match the characteristics of the general school population in the Czech Republic (except for neglected audiences), and they were compensated with table games or LEGO sets valued at approximately 20 EUR.

We conducted an inductive thematic analysis on the transcribed interviews using Atlas.ti 24 for Mac, with two coders reaching a consensus on the coding. Later, we also did a frequency analysis for each preconception. It is important to mention that the occurrence of a preconception in a child means that the child spontaneously mentioned it. Therefore, if a preconception has a low frequency, it means that not many children spontaneously mentioned it, not that many children do not have it. It could be that they didn't talk about it (due to various reasons) or they simply didn't know. It could happen that one child could have multiple preconceptions.

3 Results

We identified 15 unique preconceptions, all listed in Table 3. The most common preconception was that *the inside of a smartphone is identical to a desktop*

computer, only everything is smaller ($n = 35$; 71%). Some children believed that certain components are found in both smartphones and computers, such as *memory* ($n = 4$; 8%), *battery* ($n = 6$; 12%), and *processor or some centre* ($n = 4$; 8%). We did not distinguish between types of memory.

Fifteen children (31%) reported that *a smartphone has far fewer components than a computer*. Some components were identified as absent in smartphones, such as a fan ($n = 9$; 18%) and *processor or some centre* ($n = 1$; 2%), or *as being fewer in number*, such as *cables* ($n = 4$; 8%). Interestingly, while 11 children (22%) believed that *a computer has more memory than a smartphone*, one child (2%) expressed the opposite view, stating that *the smartphone has more memory than the computer*.

Eighth-graders descriptively tended to have more preconceptions related to "invisible" components (e.g., *both smartphone and desktop have a processor or centre*), though these results were not statistically significant. Overall, the results suggest a low level of awareness about this topic among children in both age groups.

Table 1. Preconceptions about the differences and similarities between smartphone and desktop components. Percentages are expressed from the number in the given group.

Preconception	**Total**	**Grade 6**	**Grade 8**
inside of a smartphone is identical to a desktop computer, only everything is smaller	35 (71%)	16 (64%)	19 (79%)
smartphone has fewer components than desktop	15 (31%)	9 (36%)	6 (25%)
desktop has bigger memory (of unspecified type) than smartphone	11 (22%)	7 (28%)	4 (17%)
desktop is more efficient than smartphone	10 (20%)	4 (16%)	6 (25%)
smartphone does not have a fan	9 (18%)	4 (16%)	5 (21%)
both smartphone and desktop have a battery	6 (12%)	1 (4%)	5 (21%)
both smartphone and desktop have a centre/processor	4 (8%)	0 (0%)	4 (17%)
both smartphone and desktop have a memory (unspecified)	4 (8%)	0 (0%)	4 (17%)
smartphone has fewer cables than a desktop	4 (8%)	2 (8%)	2 (8%)
both smartphone and desktop have unspecified discs	2 (4%)	1 (4%)	1 (4%)
components are stored differently in a smartphone than in a desktop	2 (4%)	0 (0%)	2 (8%)
components are wired differently in the smartphone and in the desktop	2 (4%)	1 (4%)	1 (4%)
smartphone has metal parts	1 (2%)	0 (0%)	1 (4%)
smartphone does not have a centre/processor	1 (2%)	1 (4%)	0 (0%)
smartphone has bigger memory than a processor	1 (2%)	1 (4%)	0 (0%)

4 Discussion and Conclusion

Our findings strengthen and extend the abovementioned existing body of literature in this area by identifying 15 preconceptions. Some of these preconceptions are partially described (albeit in different words) in the literature (e.g., [1], [6]), and we confirm their existence in a new, younger, and larger sample. Others are novel (e.g., *smartphone does not have a fan*). At the same time, the results offer

practical implications, as they can assist teachers in focusing their lessons on highlighting the similarities and differences between smartphones and desktop computers, emphasising that elementary components such as the processor can be found in all such electronic devices, but that there may also be differences in material, size or wiring.

When comparing the two age groups, we observed that older students were generally more likely to even identify specific components. The underlying reasons for this were not revealed in the interviews. We speculate that eighth graders may be more familiar with the internals of a computer than a smartphone, leading them to make assumptions about its components. Generally, eighth graders tended to have more scientifically accurate preconceptions (e.g., *both smartphone and desktop have a centre/processor*).

However, this research has certain limitations. The sample size and diversity could be improved for better generalisability; especially, we were unable to recruit participants from disadvantaged communities. Additionally, the online format reduced our control over the children's activities during interviews.

Our next step will be to develop educational materials tailored to different levels of children's knowledge about hardware components and architecture, based on their preconceptions. The goal is to guide students from these preconceptions to a more accurate, scientifically grounded understanding.

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