









**Figure 3. The diagram shows time for creating UIs with SketchBuilder and UIBuilder. Further, the time for creating UI sketches is depicted as separate series. It appears that drawing sketches takes a significant amount of time.**

ingly high, and is likely because the given UI contained only few elements. On the UI canvas, participants made only corrections in the alignment of the widgets. The need for corrections in the placement of the widgets and the considerable amount of time for the drawing of the sketches make the SB approach slower compared with the UiB. Even though it took longer time to complete the tasks, 12 of 16 participants stated that they would prefer to work with the SB. As reasons they stated “working with the SketchBuilder is fun” or “it is faster”. They also rated (Likert scale: 1=very low; 5=very high) the effort for working with SB lower ( $M=2.0$ ,  $SD=0.8$ ) as with UiB ( $M=2.9$ ,  $SD=0.9$ ).

Regarding the general concept, participants found that learning to use MobiDev is simple ( $M=4.6$ ,  $SD=0.5$ ) and the concept is easy to understand ( $M=4.1$ ,  $SD=0.7$ ). One participant suggested that sketches could be easily reused for other projects and also for working together with others. Another indicated that starting to develop an application could be done without the use of a mobile phone. Another participant suggested, “MobiDev would be great for teaching beginners how to write programs”.

## CONCLUSIONS

In this paper we introduced MobiDev, a mobile application development tool that allows the creation of mobile apps without the need for hardware other than a mobile phone. The evaluation showed that it’s possible to transform paper prototypes into executable code with a very high recognition rate of 98%. Further results show that creating UIs with SB is slower than working with the UiB. However, the great majority of participants stated that they would prefer the SB. From the qualitative feedback, we conclude that one reason for this is that working with the SB is fun and more pleasant compared to the UiB. Which approach for creating UIs is to prefer cannot be answered in general. As participants suggested, sketches of UIs can be reused. Also several people can collaborate and draw sketches together, which would be transformed to UIs by one mobile phone later. Therefore, SB and UiB are two approaches that supplement to each other. The latter is, to the best of our knowledge, the first mobile implementation of graphical

user interface builder, which supports creating functional UIs.

A mobile application development tool as MobiDev will never be able to replace fully-grown integrated development environments for desktop computers. Limitations of mobile phones as a developing platform are too strong. However, for people in parts of the world where the mobile phone is the only available computing device MobiDev creates new options. It can be used for educational purposes as well as for creating applications for the own benefit.

The current prototype does not implement all aspects of the concept. Thus, next steps would be to investigate how the SB could be extended to recognize application flow charts. Additionally, coding assistance tools like code templates or methods as shown in TouchStudio [6] could be integrated to facilitate the coding process. Another interesting aspect is how mobile phones with integrated projectors could be used for creating UIs. Augmenting the interface of MobiDev with projected parts could help to overcome issues that are inherent to the size of mobile phones.

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