Student Safe: the Magyar Nemzeti Bank's retail central bank digital currency pilot project

Contents

1. EXECUTIVE SUMMARY

Student Safe was the Magyar Nemzeti Bank's (MNB) pioneering Central Bank Digital Currency (CBDC) pilot project, which aimed to increase financial inclusion, develop digital financial skills and test modern payment solutions.

The Student Safe, as an innovative mobile application, **offered free of charge and secure digital payment solutions to support the financial inclusion of 8-14 year olds.** It provided users with the opportunity to learn the theory and practice of digital finance basics through a combination of quizzes and mobile banking functions.

Throughout the shaping of the Student Safe, **from the product development process via testing and operation, the active involvement of the target group** (e.g. during summer camps or school presentations) was carried on. Based on user feedback, the app was continuously fine-tuned, further improving the practical operation of the application supporting intuitive and experience-based financial learning.

In addition to the **user-side functionality of the application, the development of the administrative and regulatory framework also received particular attention**, thus ensuring full compliance with data protection and financial safety requirements.

The aim was to create a central bank digital currency environment that is not only secure and regulated, but also flexible and user-friendly. The complexity of the Student Safe project required close cooperation amongst a number of actors, including commercial banking partners, FinTech companies and different professional areas of the MNB. Experience has shown that the **introduction of central bank digital currency poses not only technological, but also regulatory and organisational challenges**.

The successful operation of the Student Safe **required the development of a well-structured and efficient operating model** that ensured the continuous availability, security and user-friendly operation of the system.

With the help of the app's version enhanced with mobile banking functions, the MNB was able to gather practical experience **under real-life conditions, involving a focused user community, on the development and operation of a central bank digital currency system, including the deployment of IT systems, customer relationships management, fraud prevention, user interface design, and cooperation with market participants.**

Through the operation of the Student Safe, the MNB gained valuable experience on user habits, on the acceptance of digital payment systems and on the ability to integrate new technological solutions into the central bank environment. It also **demonstrated its ability to proactively contribute to the development of digital financial systems in a prominent way also on the international stage**, and is well prepared to meet the challenges of the future by creating an innovative financial environment.

2. INTRODUCTION

With today's digitalisation efforts, including the increasing demand for fast, secure, cheap, widely available and instant digital payment solutions, **central bank digital currency (CBDC) has become one of the most actively researched areas among central banks**[1]. Central bank digital currency, like cash, represents a claim on the central bank, but in a previously non-existent, digital form. In terms of use, there are **two types of central bank digital currencies**: retail and wholesale CBDC. **Retail** is for general transactional use by economic agents (as is the case for cash or commercial bank money), while **wholesale** is used to support the financial intermediary system and cross-border transactions. There is no general guideline on the need to introduce CBDC, it is up to the central banks to assess this, taking into account the development of the economy, social and geographical conditions. The integration of CBDCs into the financial system may be justified where economic and social failures can be identified whose mitigation goes beyond the current instruments available. The costly and environmentally damaging operation of cash logistics, the rise of electronic payment habits or the development of financial inclusion in society can be interpreted as such a phenomenon. Although the impact of these phenomena in the Hungarian financial system does not, in our current assessment, justify the urgency of introducing CBDC, the MNB is committed to research in this area, because as a well-prepared, digitally mature institution, the Bank can make future decisions and manage transitions more smoothly.

3. MNB CENTRAL BANK DIGITAL CURRENCY APPROACH

In Hungary, the basic financial infrastructure is well developed, and its active use is facilitated by a number of central measures. The domestic financial system is well developed, actively embedded in the European banking system, and an increasing number of domestic and international FinTech solutions also support the flexible management of retail finances. In addition, a number of recent government or central bank measures have also helped the acceptance and spread of electronic payment solutions, such as the mandatory provision of electronic payment options by service providers with online cash registers from January 2020, or the introduction of instant payments by all domestic credit institutions from March 2020. In addition, the domestic population has a strong attachment to cash, which demand by the consumers is also supported by the MNB with specific measures, such as MNB Decree 1/2023 (I. 17.) requiring availability of ATMs with adequate density and modern functionality.

The public's money use and payment habits are conservative, so the conscious use of money, including the benefits of digitalisation, still needs to be strengthened. In this context, central banks should support the full satisfaction of current payment needs at low cost and with low environmental impact, and should also work continuously to promote the informed choice of

[1] CBDC tracker - https://cbdctracker.org/

advanced, convenient, secure and essentially digital solutions by actively supporting financial literacy and digital financial inclusion.

The MNB does not want to be a follower but an active shaper of the way of thinking regarding the money of the future. The MNB is committed to consciously researching the possible forms and uses of the money of the future and the technologies that will make them possible. The MNB will support the use of cash as long as there is a demand for it by the public. But it also wants to be prepared for the opportunities and challenges of the future, where one thing is certain: the money of the future will be digital. It must also fulfil the main functions of money, i.e. it must be a unit of account, a medium of exchange and a store of value. This could be interpreted as a future demand for a risk-free, widely accepted means of payment in the digital space, similar to cash today.

There are already many competing concepts and implementation attempts regarding the concrete form of the money of the future. The crypto or virtual money ecosystem is built around the idea of digital money, in which the first major form of implementation, Bitcoin, still plays a prominent role. However, privately issued digital assets are far from being risk-free, so the digital currency function is increasingly being populated by the so-called stable cryptocurrencies or stablecoins, which are issued with real financial asset backing in virtual, decentralised markets, in an increasingly regulated framework[2]. The digital currencies issued by regulated financial institutions, on the other hand, are based on the tokenisation of banking instruments, and as such are the embodiment of the evolution of the commercial bank money that are now known and used, but on a new platform. However, due to issuer risk, they cannot live up to the risk-free and universal acceptance of cash either. Central bank digital currency promises to deliver this digitally.

The MNB believes that the introduction of central bank digital currency that is not a substitute but a complement to the forms of money known today is sustainable. A key added value of central bank digital currency is that it allows issuing central banks to remain relevant in controlling payment flows and thus implementing their own monetary policy in the digital age. However, maintaining monetary sovereignty does not require the crowding out of regulated market forms of money, and commercial bank money and underlying deposits are still needed to maintain banks' ability to finance the economy. The aim is therefore to develop a central bank digital currency concept that is in line with domestic development trends, that offers a risk-free and generally accepted digital payment solution, and that is interoperable with other digital or cash-based payment solutions.

Several similar concepts have been already developed in the international arena of central bank digital currency research. The main economic policy regions have so far presented very similar concepts in terms of functionality, the main difference being in the stage of implementation. The most advanced is the Chinese central bank digital currency, the e-CNY, followed by the digital euro

[2] Regulation (EU) 2023/1114 of the European Parliament and of the Council on markets in cryptoassets (MiCA)

and the digital pound[3]. All of them focus on the universal payment instrument function, by maintaining a two-tier implementation, i.e. customer relationships remaining with regulated market players. However, by having a stable financial intermediary system, backed by deposit insurance, and a well-functioning, actively used instant payment system that is mandatory for all institutions, complemented by FinTech solutions built on them, the added value of this concept from a user perspective is limited. So, while it has strategic advantages, mainly in terms of supporting resilience and sovereignty, it also carries risks of so-called disintermediation, i.e. the risk of a one-off or general withdrawal of commercial bank deposits, which could render the current commercial banking operating model impossible, but also pose implementation difficulties due to the new task for central banks. The costs and benefits of implementing the model are at the discretion of the responsible decision-makers in each jurisdiction.

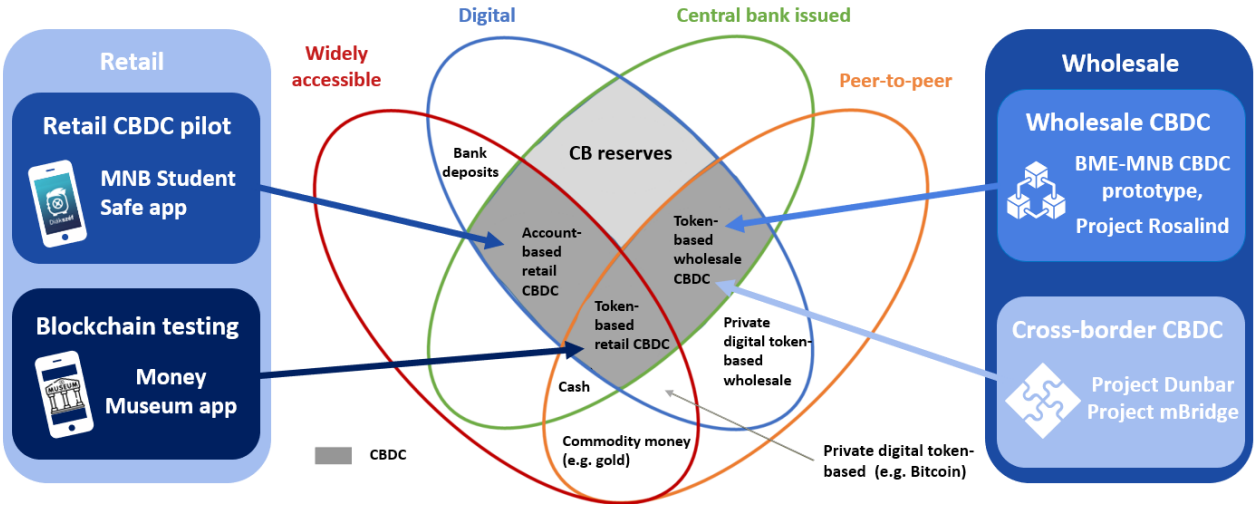
The MNB has not yet committed itself to the need to introduce a general-purpose, widely accessible central bank digital currency, in addition to further developing the instant payment system. As a sovereign central bank, while maintaining its own and the country's monetary sovereignty, it can also define its concept for central bank digital currency independently, according to the domestic environment and criteria, while keeping abreast of international research and developments. In light of this, it will continue to explore the possibilities for identifying those market failures or policy considerations of strategic importance that could be the basis for a central bank digital currency strategy with greater added value, aligned in its concept and design.[4]

The MNB learns and gathers experience through fully fledged tests, involving real consumers. An important part of research on central bank digital currency is to understand and monitor user and technological trends. The MNB is doing this through a unique approach among central banks, which is essentially the approach of market participants, through services provided to real consumers. Our aim is to launch pilot projects in as many areas as possible, covering a wide range of technological and functional implementation directions for central bank digital currency, which are targeted, end-to-end implementations of use cases that offer solutions to real problems and are therefore also attractive to real customers (Chart 1).

[3] The development of the digital dollar was halted by President Donald Trump's executive order of 23.01.2025, which also focused on cryptoassets and digital tools to establish and maintain the dominance of the USD in the digital space.

[4] Fáykiss-Szombati (2020)

Chart 1: MNB CBDC pilot projects



Source: MNB.

In solving these novel challenges, not only the end goal but also the journey itself is important, with many useful lessons to be learned. The implementation of these pilots, i.e. pilot projects with full functionality but with a smaller number of users, is a completely new task for a central bank, as no such institution has developed an application specifically targeting the general public yet. However, programmes and mobile applications that provide direct contact with the public, which is desirable in the digital age, must offer equally high standards, convenience and security as other digital services. To achieve this, central banks need new tools, new project management methods, new capabilities and new functions. Therefore, the MNB has already followed the agile approach in the implementation of its central bank digital currency pilots, based on the design thinking methodology, and has strived for short deadlines and deliverables in the implementation of projects. Colleagues who participated in the project gained skills and experience that will serve as an ideal basis for future projects in the central bank, covering a wider range of users. The exploration, testing of technologies related to the issuance and use of central bank digital currency, as well as gaining experience will also provide far-reaching lessons. The complexity of the Student Safe, which is a retail payment mobile application with a wide range of functionality, targeting multiple consumer groups and using playful learning methods, models the main elements of a future project covering the entire population, so the implementation and making available of the application and its operation for a year and a half provided extremely valuable experience. With this background knowledge, there is a good chance of shortening the so-called “time-to-market” between the decision on the possible introduction of central bank digital currency in the domestic retail market and it becoming actually available.

4. MNB'S RETAIL CBDC PILOT PROJECT

4.1. Financial inclusion

One of the biggest challenges for central banks is to improve access to financial services and to develop financial awareness. According to the World Bank's 2021 survey[5], 24 percent of the world's adult population globally does not have a bank account, and although in Hungary this indicator is half of the global figure, hundreds of thousands of Hungarians are affected by this. Among those who do not have a bank account, the most common reasons were low wealth or income levels and the high costs of financial services. However, these considerations are complemented by the challenges of using digital tools, since, like most services, personal finance is now largely managed digitally[6]. The CBDC can help these inclusion developments by offering a low-cost and secure digital payment solution to help develop digital skills and provide access to digital payment infrastructure alongside cash. Improving financial literacy and financial awareness is also essential for developing financial inclusion. In Hungary, according to the analysis of the OECD and the MNB, although the level of financial literacy is adequate, its conscious and practical application is significantly lower[7]. In addition, the penetration of banking connections and digital payment solutions is not universal, with around 13 percent of the adult population in Hungary not having access to such solutions[8]. A more difficult to measure, but certainly higher proportion of people who formally have a bank account but still prefer to manage their day-to-day finances in cash also exists, who thus miss out on the flexibility, speed and convenience of digital solutions. Thus, by presenting and raising awareness of these benefits, there is still room to modernise domestic payment habits beyond the present forms of money[9].

4.2. Design of the Student Safe CBDC functions

Based on the successful launch of Student Safe 1.0 in 2020, which is essentially a playful educational tool, and the positive experience gained afterwards, **the MNB decided that it is worth considering further development of the system** and targeting primary school-age students and their parents by providing a fully functional, free of charge electronic money account by the central bank. The design of the Student Safe 2.0 retail CBDC pilot project was based on a model developed by the MNB, consisting of seven separate, sequential decision-making steps (Chart 2).

[5] World Bank: The Global Findex 2021 - https://www.worldbank.org/en/publication/globalfindex

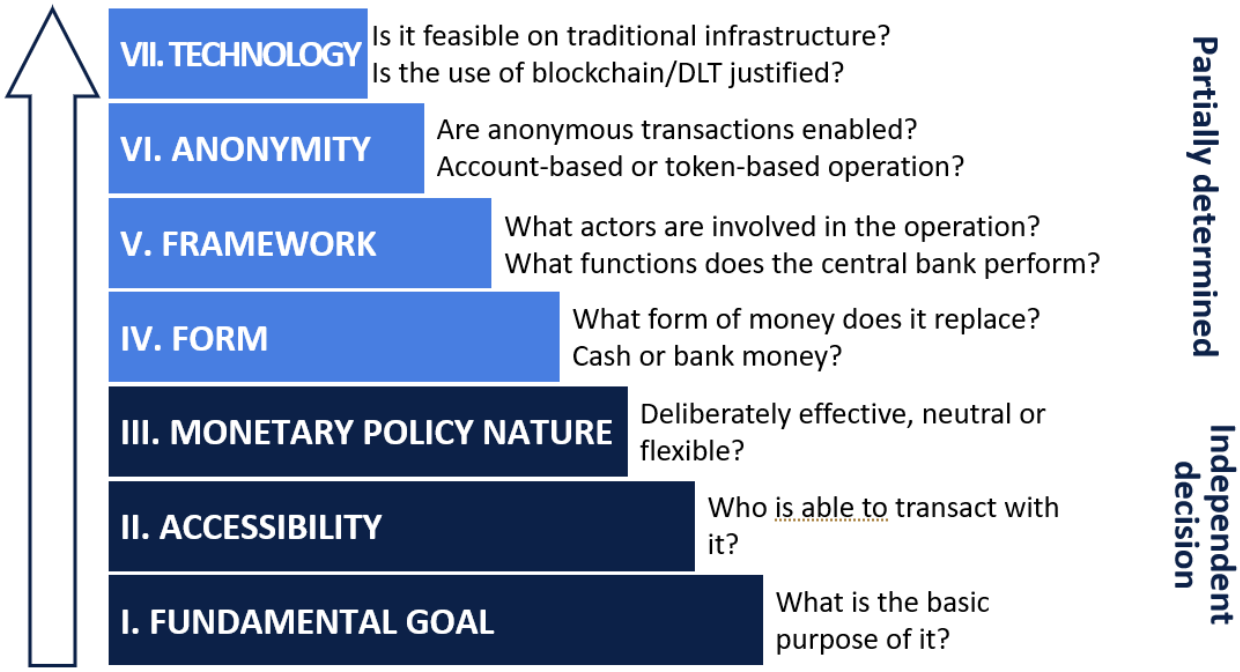
[6] Household payment habits 1. - https://www.mnb.hu/letoltes/lakossagi-fizetesi-szokasok-1-resz.pdf

[7] The state and development of financial literacy in Hungary – https://hitelintezetiszemle.mnb.hu/letoltes/hsz-23-1-je1-hergar-kovacs-nemeth.pdf

[8] See footnote 6.

[9] For more information, please refer to the Cash flow strategy to 2030 – https://www.mnb.hu/letoltes/penzforgalom-2030-strategia.pdf

Chart 2: Decision steps in designing a CBDC system



Source: Fáykiss and Szombati (2021)[10].

I. Fundamental goal

The starting point for the design is to **formulate the motivations for introducing CBDC, what market failure it can help to resolve or what policy objectives it can help to achieve**. The MNB decided to launch a retail CBDC pilot project to gain practical experience in this challenging new area. It also aimed to promote digital financial inclusion of primary school age children.

II. Accessibility

In the second step, it is useful to define the scope of the actors with possible access to CBDC. The MNB was one of the firsts to set up a pilot project for a dedicated social group of 8-14 year olds and their parents. As part of the payment ecosystem that was be built around Student Safe, merchants who join the system could also have access, as well as their employees who process payment transactions with limited access to the system. Although the main target group is families, the app and access to the CBDC was available to all adult Hungarian citizens.

[10] Egy új kor hajnalán – Pénz a 21. században [At the dawn of a new era – Money in the 21st century] – https://www.mnb.hu/kiadvanyok/mnb-szakkonyvsorozat/egy-uj-kor-hajnalan-penz-a-21-szazadban

III. Monetary policy nature

The third independent decision relates to the fundamental monetary policy framework, i.e. whether to create an active, neutral or flexible instrument. The CBDC issuance within the Student Safe was performed in the form of electronic money, on which holders by definition cannot earn interest. Low holding limits have not led to a significant reduction in the liquidity of the banking system. Overall, the monetary policy impact of the Student Safe was neutral.

IV. Form

In the fourth step, **the form of the CBDC,** partly determined by previous decisions, needs to be defined, including **whether it should be a bearer instrument, which can be used freely by the holder, or account-based, which requires the cooperation of the account manager and the account holder**. In the case of the Student Safe, it is an account-based form of money, its electronic money nature can be integrated into the financial infrastructure. It is also worth defining further features of the usability of the financial instrument, such as whether it should be available for cross-border transactions or whether it should provide for an offline payment option. In the case of the Student Safe, these functions were not implemented in the first round.

V. Framework

In the fifth step, when establishing the framework, **the actors involved in the operation of the CBDC and the division of tasks between them should be defined**, as the operation of the system, which poses new challenges for central banks, may require the involvement of partners and payment service providers. This time the MNB issued the CBDC with a commercial banking partner. With the involvement of the custodian bank, Student Safe users were directly connected to the instant payment system, so that at any time they could initiate an instant transfer to accounts managed by Hungarian banks. The Student Safe was designed with a modular platform, allowing for the expansion of both the range of partners and the services provided.

VI. Anonymity

In the sixth step**, the necessity and conditions for anonymous transactions should be examined, since in relation to the use of cash, the retail central bank payment instrument available so far, the demand from users for undetectable payment solutions is also significant in the digital space** (privacy). The Student Safe used a two-step KYC[11] process, no detailed personal data was required at the basic level, transactions were allowed up to a HUF 15,000 limit, while for the extended account the holding and transaction limit was HUF 300,000 after KYC and AML[12] verification.

[11] KYC – The "Know Your Customer" process identifies and confirms that the customer is who they say they are.

[12] AML – Anti Money Laundering – Screening preventing terrorist financing.

VII. Technology

The seventh and final step is to define the framework for **whether the CBDC should operate on a traditional, centralised infrastructure or whether the required functionalities could be better supported by a new, e.g. decentralised ledger architecture**. The design did not include any aspects that would have required a distributed ledger technology, so the Student Safe operated on a centralised system, which allowed collaboration with commercial banking and FinTech partners. At the same time, the modular design of the solution allows it to be converted into a distributed ledger system.

4.3. Student Safe mobile app

4.3.1. First version of the Student Safe, background story

The **Student Safe mobile application was launched in 2020** as a joint initiative of the MNB and the Money Compass Foundation[13], with the aim of improving young people's financial awareness and strengthening digital financial inclusion.

The basic idea for the Student Safe was inspired by the previously operating Savings Stamp Programme. **In Europe, initiatives to encourage savings go back to a long time.** Already in the 19th century, there were programmes where teachers opened a savings book for children, where they would enter the money they saved each week. In Hungary, the school savings scheme was launched in 1953 with the establishment of the Savings Bank for Teachers and Students, and the first school savings stamps were issued as part of this scheme. During the school year, students could buy stamps from designated teachers and stick them on collection booklets, and at the end of the school year they could redeem the money they had collected and the interest they had accumulated until then. The collection of stamps with interesting and varied illustrations motivated the students to save money in a playful way and taught them to manage their money regularly. However, since the Savings Bank was closed in 1992, there has been no savings motivation programme in place for students in Hungary.

With its launch in 2020, the Student Safe mobile app targeted the 8-14 age group by giving a modern, digital twist to the previously popular stamp collection format. By correctly answering financial, digitalisation and sustainability quizzes, the students received so-called **Digital Savings Stamps** worth of Student Coins[14] of a specified value. These stamps, with different graphic designs, formed series on a number of themes (e.g. Famous domestic buildings, Marine fauna), which could

[13] The Money Compass Foundation was established in 2008 with the aim to develop and implement financial education and awareness learning materials and programmes in cooperation with public authorities, NGOs and market players, like a "compass". https://penziranytu.hu/

[14] Student Coin (SC): a unit of account within the Student Safe that is not electronic money; a Student Coin is not legal tender and does not constitute a claim to legal tender.

then be treated as a collection. This provided an extra motivation for students interested in collection.

In the design of the quizzes, particular emphasis was placed on matching the questions to the assumed knowledge of a particular age group for each topic. Based on their age, the students were divided into 2 age groups; 8-11 year olds (lower primary school) and 12-14 year olds (upper primary school). The questions were compiled and formulated by teachers in primary schools. After completing a quiz, the correct answer and its explanation were summarised in a detailed "student message". The Student Coins could be exchanged for gifts in one dedicated online shop.

The success of the programme was demonstrated by the fact that **students had completed more than 1 million quizzes by May 2023**.

4.3.2. Design of a Student Safe 2.0 mobile application

One of the key elements of the Student Safe 2.0 project was the application of **design thinking methodology**, which ensured that real user needs were at the heart of the development process. Through an iterative design process, the MNB has ensured that user needs and feedback are incorporated into the project at all stages of development. An important part of the concept was that the mobile application should not be based on (theoretical) user expectations as described in the studies, but should involve real children.

Members of the Digitalisation Directorate met with members of the target group several times during the design and testing phases, organised by the Money Compass Foundation. The most comprehensive cooperation was finally realised in the framework of a summer camp supported by Student Safe, involving several dozen students (10-14 years old, with a boy/girl ratio of 50 percent each), where, in addition to MNB staff, the company developing the application and the experts from the company responsible for UX/UI[15]also participated. Information was collected in three areas, during which the **children** (1) could try out the first version on test phones and give immediate feedback **on how to use the application**, (2) gave answers on their attitudes towards **pocket money collection and cash use** based on personal interviews, (3) **provided creative help** with marketing (e.g. poster design, catchphrases) in a playful environment. The information received was later evaluated together with the development team.

Later on, the **fine-tuned version was first tested by MNB employees and their children (Friends&Family), and then our staff** presented it **in person** at several primary schools, where a questionnaire was used to find out which big online store the children would prefer to spend their reward provided to them in the form of Student Coins.

[15] User eXperience (UX): user experience, User Interface (UI): user interface

4.3.3. Launch of Student Safe 2.0

After careful planning and preparation, the **Student Safe was revamped in 2023 to include real money management**, **adding mobile banking functionality** to the previously playful, educational-purpose app. Users were able to make HUF-denominated electronic money transactions, top up their balance by bank card and transfer money to any domestic bank account via the instant payment system. They could save money by setting targets that were important to them with the help of the so-called "piggy bank", while respecting their wallet limits. They could make purchases using QR code payments in shops or online stores that were directly connected to the system or where the SimplePay Instant Transfer service was available.

The electronic money accounts of students and their parents were managed directly by the MNB. The service was completely free of charge, i.e. no account management fee or other transaction fees were charged.

The mobile banking functions of the app **offered advanced solutions** such as requesting and sending money, "piggy bank" function (target-oriented savings), flexible management of transaction limits. The app was available under parental supervision, parents could track their children's savings and reward them with pocket money (in HUF or Student Coins) by assigning specific tasks.

Even after the renewal of the Student Safe, the playful, educational features to earn and collect Student Coins were preserved. In addition, **the usability of the Student Coins was expanded**, as from that point on the Student Coins could be redeemed for vouchers for online shopping instead of the limited choice of gift items.

In the case of Student Safe 2.0, in addition to the quizzes, the **"Did you know?"** message that appeared daily on the home page of the mobile application also supported the educational goal. These messages contained interesting facts about finance, digitalisation and sustainability, which were later also published as quiz questions.

As a community feature, the home page also allowed users to follow their own events, those of family and friends, and to add friends via QR code requests from among students. The programme already allowed students to swap stamps between each other for the same value, in order to obtain a full series more quickly.

5. PILOT PROJECT MANAGEMENT

5.1. Legal and regulatory considerations

In designing the Student Safe system, particular attention had to be paid to both the technical and legal feasibility aspects. This last issue required a particularly thorough assessment, given the need for a solution that would allow rapid market introduction in order to start gaining experience

as soon as possible in the pilot. Accordingly, under the conditions of the current regulatory environment, and without waiting for a potentially lengthy legislative procedure, the MNB had to find an actual legal operating model that would allow the issuance of central bank digital currency[16] and, through it, the balance management – as a direct claim on the central bank.

With the launch of the Student Safe in 2023, the MNB implemented the issuance of electronic money, which is allowed by the current EU and national regulations. Based on the legal provisions currently governing the MNB's operations and its toolkit, given that the MNB is not in a position to operate payment accounts for retail customers, the MNB may issue central bank digital currency to the retail sector only if, pursuant to the provisions of Act CCXXXV of 2013 on Payment Service Providers ("Fsztv."), as an electronic money issuer within the meaning of Section 3(7) of the Fsztv., it issues electronic money under Section 6(1) Item 16 of Act CCXXXVII of 2013 on Credit Institutions and Financial Undertakings ("Hpt."), however, this does not have to be accompanied by the keeping of a payment account. In this implementation model, the e-money balances were recorded at the MNB, so there was a direct link established with the users of the system as customers. Although electronic money issuance has so far been mainly a market activity, Directive 2009/110/EC of the European Parliament and of the Council at EU level clearly allows central banks to carry out this activity also, provided they do not act in their capacity as monetary authorities.

The MNB applied voluntary legal compliance to ensure that there were regulated processes in place to protect customers. EU market operators can carry out e-money issuance activities subject to authorisation, which requires the prior submission of a detailed authorisation dossier, against which supervisory authorities will assess the readiness and suitability of the market operator concerned to provide this financial service during the authorisation procedures. However, as mentioned above, the MNB is in a special position in this respect, as it is legally authorised to issue electronic money, however, does not need to comply with the relevant licensing conditions under the current EU and Hungarian legislation (Fsztv.)[17]. Despite its legal exemption, the MNB has voluntarily ensured legal compliance with the conditions for obtaining an e-money licence. The necessary documentation, opinioned by the supervisory areas of the MNB, was prepared by the central bank's experts, which provided the necessary basis and preparation for the start of the activity, and the customer protection rules were thus also applied with due care.

The central bank also ensured the enforcement of rules to prevent and combat money laundering and terrorist financing in the Student Safe through voluntary compliance. Although the application was focused on a well-defined group of users due to its pilot nature, and the scope of Act LIII of 2017 on the Prevention and Combating of Money Laundering and Terrorist Financing

[16] BIS Central bank digital currencies - https://www.bis.org/cpmi/publ/d174.pdf

[17] We would like to note that some of the rules that apply to its electronic money issuer, in particular the rules on customer protection, are also applicable mutatis mutandis to the MNB.

("AML Act") does not cover the MNB's activities related to the Student Safe, the MNB voluntarily applied its rules in accordance with the Student Safe's general terms and conditions, as part of a risk-based approach. This provided the MNB with the opportunity to gain experience in this area, also addressed the money laundering risk of mobile app transactions and, last but not least, ensured consistency with the system of requirements applicable to market participants. This above mentioned risk-based approach was also applied for the different user groups and functions of the electronic money accounts: different customer due diligence rules applied to simple users, politically exposed persons and merchants registering in the mobile app, and different holding and transaction limits applied to basic and extended electronic money accounts that could be requested after a complete electronic customer due diligence.

In view of the specific target group of users, the functional logic and legal solutions of the application were also based on the relationship between the minor child and the parent. Focusing on the age group between 8 and 14 years old, i.e. minors under civil law, the Student Safe placed the responsibility on parents as legal representatives, both in terms of opening basic and extended functionality e-money accounts and in terms of data protection and data processing.

5.2. Project partners, co-areas and their roles

The Student Safe was also a scene for a new kind of multi-actor collaboration. The MNB implemented the aforementioned e-money issuance by keeping individual and aggregated customer-level records of e-money balances at the MNB, while the customer money received through the e-money issuance was deposited in a custody account held with an external credit institution partner. This model was not only in line with market practice for e-money issuers, but also provided important convertibility during the testing of the central bank digital currency (e.g. Student Safe transactions were also linked to the Instant Payment System through the partner). The money stored in the e-money account does not pay interest to the customers or to the central bank (on the deposit placed with the credit institution) under the current regulations, however the model has been a unique and innovative cooperation interface between the central bank and a financial market player (as the MNB, as an undertaking, has had to carry out an account opening process with the bank in question in an unprecedented way). Moreover, the system architecture developed (see below) also supported the central bank in testing other specific, technology-based collaborations, so that the pilot project not only involved financial market participants but was also linked to existing market ecosystems (Table 1).

Table 1: Partnerships for the development and operation of the Student Safe system and their characteristics

Partner	Subject of cooperation	Method of cooperation and its specifics	Direct technological connection with the Student Safe system (API)
Money Compass Foundation	Support for financial education campaign, compensation for Student Coins-based payments	- Contractual relationship to support the social responsibility of the MNB - Contact with the Online shop through the Money Compass Foundation	x
FinTech companies	System development, UX-UI design, developer operation support	Contractual relationship (resulting from procurement process)	✓
Commercial bank	Custody account management, support for the operation of the e-money system	- Contractual relationship - Monthly account management fee - Access to administrative interfaces - Certificate management	✓
Payment service provider	Processing payment transactions, e.g. bank card top-ups	- Contractual relationship - Usage-based billing	✓
Online shop	Digital redemption of vouchers expressed in Student Coins for shopping vouchers	- Contractual relationship between the Money Compass Foundation and the Online shop - Usage-based billing for the Money Compass Foundation	✓
Telecommunication company	User authentication - sending a one-time password (SMS)	- Contractual relationship - Monthly fixed fee package and usage-based billing	✓
Fraud prevention system	Checking registrations	- Platform access - Monthly fixed fee	x
Sanctions and public figures database query system	Checking registrations	- Platform access - Monthly fixed fee	x

Source: MNB.

In addition to building external relations, the development of the Student Safe and the preparatory phase required the involvement of a number of departments within the central bank. The Student Safe project was basically initiated by the MNB's Executive Directorate for Digitalisation and FinTech Sector Development, but the IT development initiated by the procurement process also involved the active participation of the areas usually taking part in such processes. In addition, given the nature of the Student Safe as a (financial) service provided, the involvement of several areas of the central bank was already necessary in the planning and preparation phase. On the one hand, the Legal Directorate, the Compliance Department, the Directorate Accounting, Controlling and Procurement, the Financial Infrastructures and Payments Directorate, the Directorate IT Services and several supervisory areas of the MNB were involved in the development and preliminary validation of the operational framework outlined earlier. Through the development of direct customer relations, a cooperation with the Customer Relations Information Centre, which provides customer support activities of the MNB, was also established, and the IT Security Department was actively involved in several processes during the project's

progress. In addition to this, the involvement of the Communication and Marketing Department was also essential in the design and consultation of the image elements and public interfaces.

5.3. Project preparations

The Student Safe was implemented as a specific software procurement process, taking into account the specificities of digital customer servicing. In the context of central banking, the provision of financial services, even on a pilot basis, is an innovative approach, but with the international advances in central bank digital currency research, there is a growing need for practical experience to be gained. For this reason, the MNB also considers it essential to understand how the time and resources required to implement such a service will evolve in practice. The implementation of the back-end systems for the operation of the Student Safe was a research and development focused process, and required a unique set of criteria, as the initial needs and requirements had to be specified in a way that was sufficiently specific to launch the process, while also allowing for the ability to respond to the rapid changes in customer demand that characterise the use of digital services and the potential future expansion of the pilot project. Throughout the preparation and development phase, both the central bank staff and the developers sought to adopt a modern, agile approach to support the R&D process, while at the same time ensuring that the procurement procedures are documented and comply with the MNB's expectations as each task progresses. The source code of the accomplished systems of both the account keeping and customer management become the private property of the central bank.

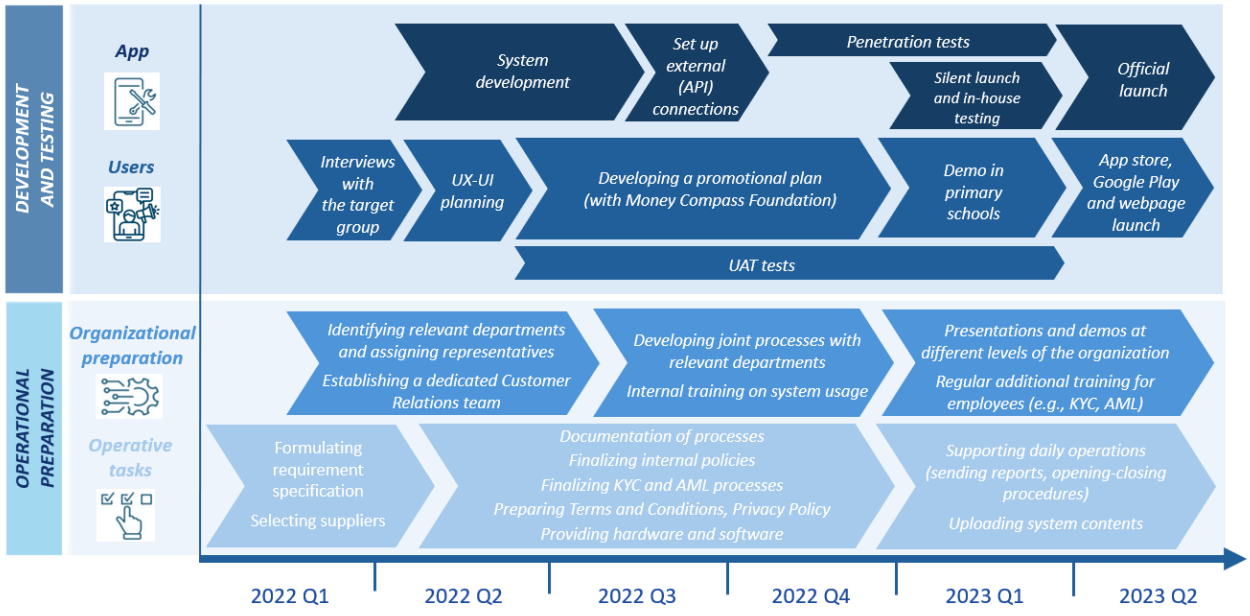
The focus in the preparation of the Student Safe was on the central bank's understanding of modern customer interface design and preparation processes. During the definition, design and development phases, a strong emphasis was placed on understanding users and incorporating their feedback, so interviews with students and parents helped to design user interfaces and functionality. The so-called design thinking methodology was used to identify the needs, evaluate the experiences based on the use of the previous Student Safe 1.0, and to develop the new design elements and user interfaces, as well as to test their usability in advance. An external partner specialising in digital product design helped the project partners to apply this methodology, thus broadening the knowledge of the central bank's experts in this field.

The preparation of the Student Safe project brought a number of novelties for the central bank. In addition to the development of the multi-component IT system, organisational development on the MNB side was necessary to ensure the implementation of both the preparatory and the operational tasks, while training of the colleagues involved in the project also proved to be essential. In order to ensure continuous operation, the framework of a related training system was also developed, and the procedures and process elements necessary for the start of e-money issuance activities had to be established. The processes for customer management and administrative tasks are laid down in an internal procedure – which was validated by an external audit process after the start of operations. One of the main innovations of the MNB's electronic

money issuance activity through the Student Safe was the development of an accounting management system, which allows the Student Safe balances to be reflected in the MNB's balance sheet and the e-money settlement process was supported through the management of four dedicated general ledger accounts.

A complex Student Safe system with a real customer relationship was gradually becoming available. The tasks in preparation for live operation were particularly extensive, as after the installation of the external development handed over to the MNB, the task was also to build up technical and administrative relations within the central bank, and to operate it with the involvement of both external and internal partners. In this context, the preparatory work required frequent testing, which justified a gradual market entry, during which it was possible to measure the practical applicability of the prepared documentation and procedures and fine-tune them before the launch. The system's fault tolerance, scalability and administrative task performance were thus back-tested in a multi-step release testing process: the system, which had undergone comprehensive penetration tests, was first made available to colleagues at the central bank, then tested in a few primary schools with the active involvement of the target group, followed by a promotion campaign in 50 primary schools, which was accompanied by the official announcement by the MNB in May 2023 of the official launch of the system (Chart 3).

Chart 3: Workflow for the preparation of a Student Safe system



Source: MNB.

The operation and continuous fine-tuning of the launched system was supported by a combination of internal and external expertise. From the MNB side, several areas supported the operational functioning (see more in section 6.3 "Student Safe in the MNB organisation"). In addition, the operational support of the system was provided by external partners (domestic

FinTech companies who were also involved in the development), through a dedicated contract, which also included possible bug fixes and related system installation tasks. The maintenance contract with the developer included an ad hoc software development framework that provided flexibility to fine-tune functionalities or even create new ones within the Student Safe system without the need for a separate add-on procurement process. Thus, during the pilot project, the further development of the mobile application was continuously ensured based on the initial experiences and the new needs that emerged, using the design thinking methodology.

5.4. Architecture, system presentation

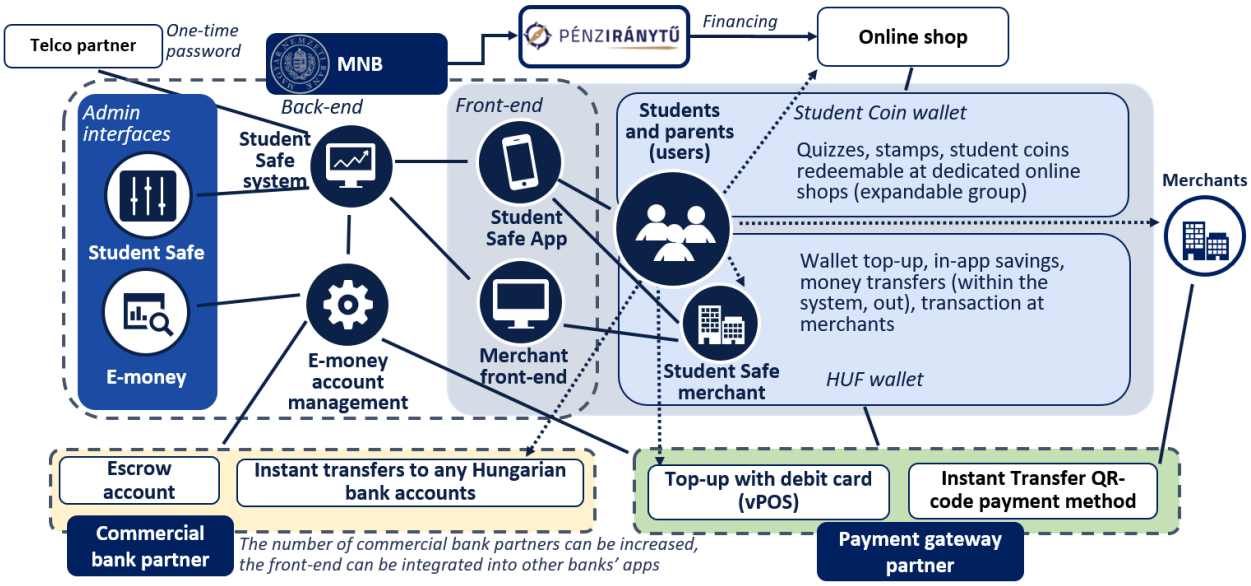
In the Student Safe system, we took a mobile-first approach on the customer side, with a view to reducing the complexity associated with functionality. The system was based on a complex architecture, as it parallelly functioned as an education-focused system with a quiz engine, together with customer administration, and an account management system with financial settlement functionalities. Nevertheless, it was an important aspect that, although the functions and roles available in the Student Safe are diverse, the user interface should be simple to use and modern. This was supported by a thorough User eXperience (UX) and User Interface (UI) design, which allowed the Student Safe solution to be available to multiple end-user groups through a single mobile app, despite the different roles (parent, student, merchant and employee) and the resulting partly different functions, in an innovative way also for the market. In practice, there were three different operational logics behind this mobile application. Depending on the customer profile, the background system chose which interface and scope of functionality to display when using the mobile application.

In addition to the mobile solution, a publicly available web application was also developed as a test, where test merchants could access their own e-money accounts and manage their employees' user profiles.

By operating these two access methods, it was possible to test both mobile (app) and web customer interfaces, which require different security considerations.

The complex but modular nature of the central system behind the customer interfaces supported the implementation of future enhancements. With the features available in the Student Safe system and the many external partnerships, the solution was highly complex. At the same time, the multi-actor, modular architecture not only ensured interoperability with already established ecosystems (e.g. instant payment, standardised QR code payment network), but also created the possibility for scalable operation and the implementation of possible future developments (Chart 4). The backend of the system was essentially centrally hosted, with four backend main components, each running on a dedicated virtual machine.

Chart 4: Schematic diagram of the components of the Student Safe system



Source: MNB.

To ensure error-free, business-continuous operation, the system was operated with multiple parallel components on multiple threads. The system supported the required availability target by running both the administrative and the account management backend systems on two server nodes each, which were located in separate server rooms of the MNB. User connections were automatically distributed between them, but in the event of a failure of any system component, operation could be maintained.

On the one hand, the Student Safe solution was implemented in such a way that both the back-end and front-end systems and interfaces had a publicly available live test version and a test version that was not open to the outside world. The latter's justification was emphasised in the case of possible bug fixes and version updates, as any changes to this complex system were first tested here, supporting business continuity across the interfaces available to customers. On the other hand, the system achieved the required availability target (greater than 99.5% per month) by running both the administrative and the account management backend systems on two nodes each. The user requests were distributed between these nodes by a dedicated MNB service (MNB Web Application Firewall (WAF)), which also increased the security level of the system.

The secure operation of the Student Safe was supported by a number of architectural and process elements, but due to its pilot status, it was still not connected to the critical infrastructure of the central bank. The basic system design principle was that, given the many new system elements and specific process features, the Student Safe system and its components should operate separately from the critical infrastructures operated by the MNB, while meeting all

requirements of the MNB-operated systems. However, in line with market practice, and with the aim of protecting sensitive data, a variety of methodologies were implemented to ensure the security of the infrastructure. Among other things, the components of the system used only encrypted communication paths and protocols in all cases, the system kept a log of all its activities – allowing the reconstruction of complete processes and the detection of possible fraud based on the log entries – and also regular backups were made.

6. OPERATION

The continuous and safe operation of the Student Safe programme required a well-planned operational system, which again required the coordinated work of several areas. The following points describe the technical, administrative and operational aspects that contributed to the smooth running of the pilot project and to optimising the user experience.

6.1. User-side functions, operations performed

The Student Safe programme was open to residential users (Adult, Student) and business partners (Merchant, Employee). A dedicated mobile interface was available for Adult, Student and Employee users to use the mobile app. The interfaces could even be changed by logging into the same device based on the actual user. They differed mainly in terms of the user functions they allowed, but also in their visual appearance.

6.1.1. Residential users – Adults, Students

The app provided **a simple and quick registration process**. By providing an email address and password, a "Basic" e-money account could be opened, which was the entry level in the customer due diligence and identification process, with as little personal information as possible. In the second phase, following the full KYC and AML process, the parent was able to register first themselves, then register their child as a Student, and then the Student completed and closed the process. For Adults[18] and Students, **registration and contracting was done entirely within the mobile app**.

Upon successful registration to the basic e-money account, the system automatically opened a HUF wallet and a Student Coin wallet with limited functionality for users. The opening of the e-money account "with extended functions" followed after the full KYC and AML check was completed.

[18] The procedure for Politically Exposed Persons was different, requiring a personal appearance.

HUF WALLET

The **HUF wallet** for the e-money account with extended functions was used for functions similar to those provided by the most modern mobile banks. The types of transactions included **top-ups with bank cards** (conversion to central bank digital currency), **intra-system money transfers** and requests, **transfers to domestic bank accounts** outside the system using the instant payment system (central bank digital currency redemption), **QR code payments** and **goal-oriented savings** (so-called "piggy bank" deposits). Parents could also support their child by setting up a regular **pocket money** (regular transfer), or even link the allowance to the completion of set tasks within the mobile app (conditional payment).

Parents could set **transaction limits** to ensure their child's safe use of money.

After the first round of registration, a **"Basic" e-money account** was opened for the user as a HUF account. At this time, the user could top up their balance up to a maximum of HUF 45,000, including the amount deposited in the "piggy bank" serving as savings pocket(s). The user could only use this balance for QR code payments at any of the contracted Merchants, where the value of a purchase could not exceed HUF 15,000. In addition, the user could also initiate a transfer to any bank account outside the Student Safe.

For the **e-money account "with extended function"**, available after a full KYC and AML check, the maximum balance was HUF 300,000. This amount could be used for unlimited QR code payments or for sending money within the Student Safe system.

Summary of main features of account types can be found in Table 2.

Table 2: Student Safe e-money accounts

	Basic e-money account	E-money account with extended functions
Balance limit	45,000 HUF	300,000 HUF
QR code payment	15,000 HUF transaction limit	Up to the maximum limit
KYC/AML	Not required	Required

Source: MNB.

STUDENT COIN WALLET

The other virtual settlement unit alongside the e-money in the mobile app was the "Student Coin". The types of transactions available with the Student Coin wallet were related to the acquisition and use of the Student Coins. The registration reward, the invitation reward, the one-off monthly allowance for child(ren) in the case of parents, and the quiz games' completion reward for students were credited in the form of Student Coins. Parents could also give their children pocket money in the form of Student Coins and a reward for completing a task/chore. Students could exchange their Student Coins from various sources for a voucher for an online shop purchase at face value within the app[19].

6.1.2. Business partners – Merchants, Employees

A mobile application platform was also developed for business partners contracted with the Student Safe programme, which **was used to process QR code payments** and could be used by Employees registered by the Merchants during transactions.

Unlike all other actors, the Merchants had access to only one web interface regarding their account, where they could register the company itself, register Employees, modify data(s), view the balance, delete the account and from here the Merchants could initiate transfers to an external account. With them contracts could only be concluded in person.

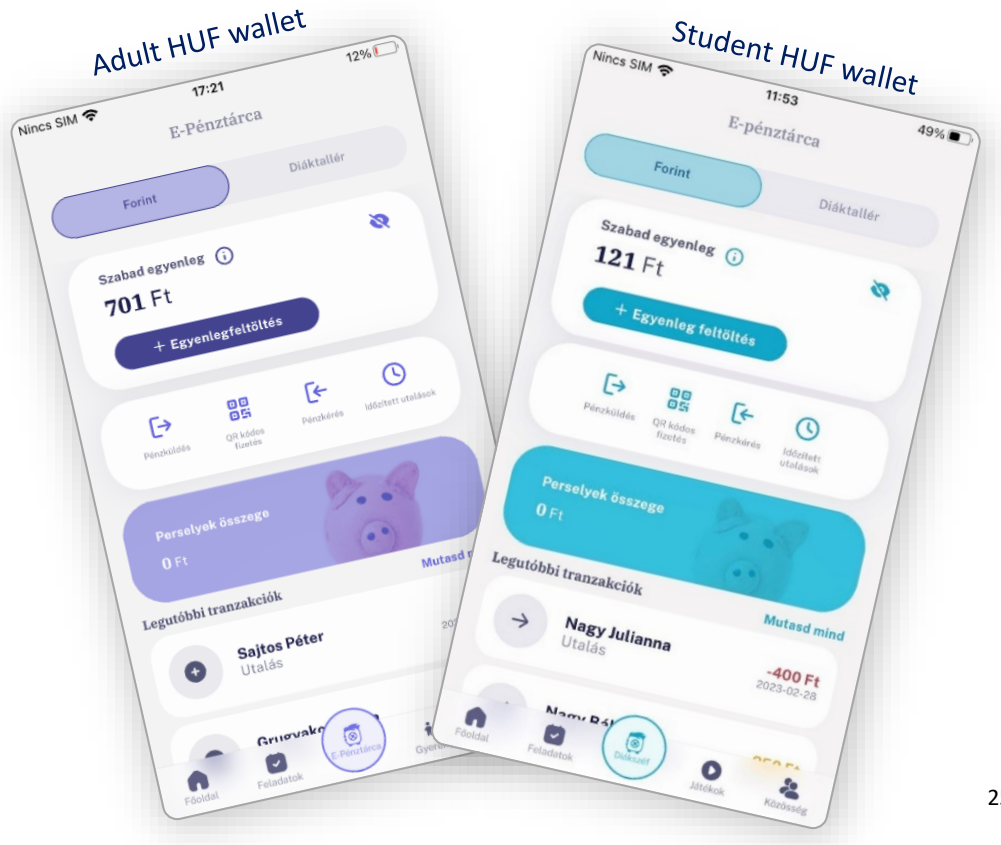
Table 3 below shows the transactions and operations that could be performed by each user type (Adult, Student, Employee, Merchant).

[19] The redemption request recorded by the student was sent directly to the online store via an API connection. The Money Compass Foundation transferred the consideration for the voucher directly to the online store.

Table 3: Operations that users can perform

	Adult (app)	Student (app)	Merchant employee (app)	Merchant (web portal)
Registration*				
▪ Registration reward	x	✓	x	x
▪ Invitation reward	✓	x	x	x
Forint transactions				
▪ Bank card top-up	✓	✓	x	x
▪ Money transfers and request to pay within the system	✓	✓	x	x
▪ Transfer to a domestic bank account outside the system	✓	✓	x	✓
▪ QR code payment via Instant Payment System	✓	✓	✓	x
▪ Goal-oriented savings (piggy bank)	✓	✓	x	x
▪ Sending pocket money in forints (one-time, recurring)	✓	x	x	x
▪ Forint pocket money for specific tasks	✓	x	x	x
Student Coins transactions				
▪ Monthly student allowance in Student Coins	✓	x	x	x
▪ Sending pocket money in Student Coins (one-time, recurring)	✓	x	x	x
▪ Student Coins pocket money for specific tasks	✓	x	x	x
▪ Completing quizzes (reward for correct answer)	x	✓	x	x
▪ Redeeming Student Coins for online store shopping voucher	x	✓	x	x

Source: MNB.



6.2. Admin platform functions and operation, admin role in operation

Due to the modular system design, **two separate admin interfaces were used** to perform direct administration tasks related to the Student Safe mobile application and its users.

- **"Student Safe admin interface":** facilitated to register and modify user data, manage Student Coin transactions and mobile app content elements.
- **"Core Banking admin interface":** the account management backend system was used to manage users' e-money accounts and for general administration of e-money accounts.

The members of the customer administration team **had different access rights to the systems, i.e. different roles to access the system.** The role of the employee determined which functions were available to them on the interface. The accounting of financial transactions, the transfer of data modifications and customer due diligence tasks were carried out according to the four-eye-principle, i.e. at least two staff members were required to sign each transaction to be effectuated.

With the two admin systems mentioned above, the staff performed their daily tasks **in three specific areas** (User Management, Mobile App Management and General Administration - Chart 5).

1. **Tasks concerning users**

With the automatically opened "Basic" e-money account, the **monitoring of new registrations** and fraud prevention activities were a priority. After registration, both Adult and Student checks were completed. As part of the process, for example, the email addresses of new users were checked.

When opening an e-money account "with extended function", **a customer identification and customer due diligence process was required** within the mobile application. The same could be made compulsory also for users who draw attention to themselves through suspicious transactions. The process was **entirely digital**, meaning that, as in the case of registration, there was no need to send in separate, signed declarations or other documents. In the case of politically exposed persons, the procedure was conducted in a face-to-face meeting.

The Student Coin redemption function **was not active** at the time of registration, and the individual authorisation of this on the administrative interface was part of the registration monitoring process. The redemption authorisation could be revoked in case of suspicious activity at a later stage (e.g. mass registration of student users within a family for a registration reward).

During the **morning opening and evening closing**, daily transactions and values were verified in the Core Banking admin interface and in the custodian bank's interface, ensuring consistency between the systems.

If **a transaction hit the limits assigned to an account**, the amount was blocked. The user had to declared the purpose of amount, and the staff member booked the amount as requested in the "Core Banking admin interface" and, in the case of a transfer to an external bank account, at the custodian commercial bank.

This area also covered the **management of customer enquiries and complaints**, which was also a focus during the planning and prioritisation of improvements.

In-app and **App store reviews** were reviewed on a daily basis.

2. **Mobile app tasks**

The **content displayed** in the mobile application (e.g. question packs for quiz games, "Did you know?" messages) was **managed** in the Student Safe admin interface by members of the administration team. The **documentation prepared for users**, such as the T&C, the Privacy Policy and the Help function in the app were also updated on this interface. The administration team was responsible for uploading the constantly renewing digital stamps and monitoring the savings targets, as well as **setting several system parameters**, such as the value of the registration reward and the maximum number of registration invitations that could be sent.

The daily task was to check the critical functions of the application and to **test it fully for new versions.**

Bugs identified through user feedback and reported by admin staff were continuously addressed. **Incidents were recorded and communication with the development companies** was handled through a closed registration platform. The identified bugs were fixed by releasing new versions, in accordance with the terms of operational support.

3. **General administrative tasks**

Daily **reports and statistics** were prepared for the managers, e.g. on financial transactions, user numbers.

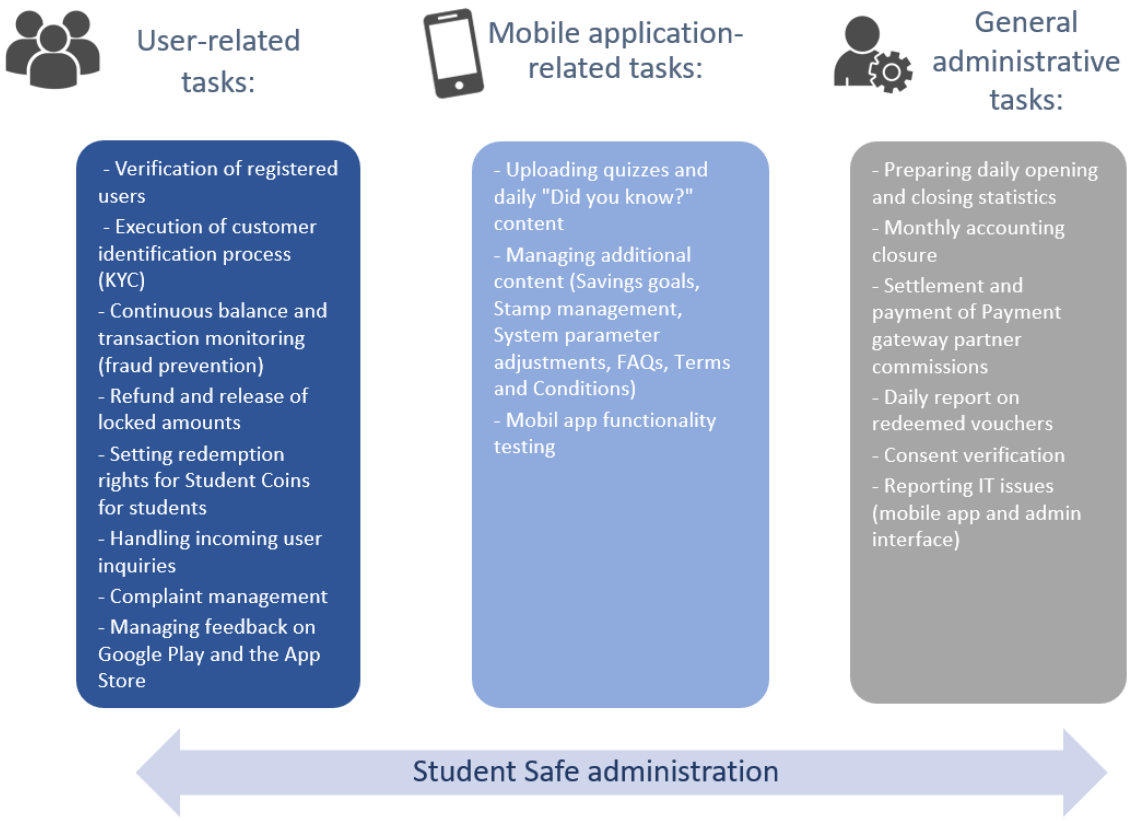
To ensure the smooth operation of the link between the Student Safe and the custodian systems, it was necessary to check the **valid consents** approved in the transfer system on a monthly basis.

A separate report on the number and amount of redemptions was prepared **to the Money Compass Foundation** on a daily basis.

A key task was to **reconcile the electronic money register and the balance of the custody account** at daily opening and closing.

There was monthly reconciliation performed with the Cost Accounting and Finance Department regarding the **electronic money register and the custody account balance**, and the **settlement** and payment of **commissions on bank card top-ups** was also carried out on a monthly basis.

Chart 5: Student Safe related administrative tasks



6.3. Student Safe in the MNB organisation

The operational and administrative processes of the Student Safe were developed in close cooperation with the relevant departments (Chart 6). This **joint work ensured** transparency and efficiency of processes and maintained a high level of financial and data security.

Areas of cooperation:

- The agreement **with the Customer Relations Information Centre** on personal, telephone and e-mail enquiries and customer complaints ensured a prompt service, thus enhancing customer experience.
- In order to ensure smooth and continuous operation, dedicated **IT administrators** were assigned to the Student Safe by the **IT Services Directorate**. In addition, system engineers were involved in troubleshooting, configuration modification or installation work for other internal IT systems connected to the Student Safe.
- In order to meet the rigorous requirements for data and information security, the channels for the flow of incoming and outgoing information, as well as the content and format of the data, were clear and strictly purpose-specific. Investigation of unusual events, e.g. mass

registration, was carried out by the **IT Security Department**, and in case of any potential data leakage, the **MNB Data Protection Officer** was to be notified.

- This being a financial programme, it was of paramount importance to monitor transactions continuously, including to detect fraud. Staff from the **Compliance Department and the Legal Directorate** helped to develop the procedures. In the light of experience, "unusual transactions" were regularly redefined and daily monitoring was carried out on this basis. In addition, the compliance area held annual training sessions on "Prevention and combating of money laundering and terrorist financing" for staff involved in the administration of the Student Safe.

- Analytical accounting was performed within the system, but general ledger accounting was implemented in the SAP system by uploading consolidated data subject to coordination by and the involvement of the **Cost Accounting and Finance Department.**

Chart 6: Collaboration with other departments

7. CLOSING THE PROJECT

7.1. Background to the decision

On 13 November 2024, the MNB representative received the **Central Bank Digital Currency Initiative of the Year Award** from the London-based **Central Banking Publications**, giving the Student Safe project a prestigious global recognition. Prior to this, MNB representatives presented the project, its initial idea, implementation and main lessons learned to interested members of the central banks and other professional audiences at several international conferences, knowledge-sharing forums and bilateral meetings. In this way, the Student Safe programme not only

contributed directly to the development of the skills and capabilities of the MNB, but also served the wider central bank community. **The project has "put the MNB on the global map" in the field of CBDC research.** This was a good opportunity for the MNB management to review the results of the pilot programme to date, as well as its future.

The first factor to be considered in the decision was the **ban on the use of mobile phones by students during school hours in primary and secondary schools in Hungary from September 2024**. This decision made it impossible for students to transact with each other during the time span when they spend the most time together and their transactions are most frequent. In addition, another typical payment situation for student users, the possibility to pay by QR code in school canteens, was terminated. All in all, the mobile phones and therefore the Student Safe mobile app became inaccessible in the very school environment that had been the main arena for promotional activities until then.

The decision also took into account the **preparations for the introduction of the digital euro**. Although no decision has yet been taken on the introduction itself, there is a strong commitment to the initiative from both key players in the European legislative circle and the European Central Bank. If in the next few years a generally available retail central bank digital currency is expected to appear in Hungary's immediate neighbourhood, in the euro area, then it is timely to consider whether it is not necessary to shift the focus of domestic central bank digital currency research towards the question of whether, in addition to the digital euro as an existing scheme, it is necessary to introduce a generally accessible digital currency in Hungary as well, and if so, what its relationship to the digital euro should be.

In this exploratory-analytical work, it will be necessary to take stock of and review in the context of domestic conditions **all the arguments and experiences that have been gathered in the CBDC research in the main research centres today, especially with regard to the announcements where the decision maker decided to stop retail central bank digital currency research and projects** (Canada, Australia, Denmark, Switzerland, etc.[20]).

In view of this, a decision was taken to **close the Student Safe pilot project on a scheduled basis** in order to ensure that capacity is available for the analytical work described above.

7.2. Operational steps for closure

Prior to informing users, detailed discussions were held with all the areas concerned on the phasing out of the application and the process for closing e-money accounts. The closure roadmap focused on three main areas:

[20] On 23.01.2025, US President Donald Trump issued an executive order banning any further research on central bank digital currency in the US.

7.2.1. Tasks concerning users

One of the most important tasks was to notify users and at the same time terminate contracts, while complying with the legal obligations related to data processing. During the communication process, **great emphasis was placed on the precise description of the tasks and key deadlines for users of the HUF and Student Coin accounts, as well as on multiple reminders relating to those**. During the two-month notice period, a weekly reminder email was sent to the customers, and relevant information was also published in the form of news in the app.

One of the highlights of the Student Safe programme was the collection of Student Coins by completing quizzes and performing tasks. The **Money Compass Foundation, as a key strategic partner, continued to provide the opportunity to redeem Student Coins also during the closure of the programme**, so that students had the opportunity to complete additional quizzes during the first six weeks of the notice period and finally redeem the Student Coins they had collected. The success of the programme's educational objective was confirmed by user feedback and the final number and amount of redemptions.

In order to ensure that all users can fully redeem their central bank digital currency into commercial bank money, the MNB paid special attention to active users. In the case of a positive e-money balance in two weeks before closure, the users concerned were contacted primarily by telephone or, in the absence of a telephone number, by personalised e-mail. As a result, **all customers were reached, and users had no outstanding electronic money claims against the MNB at the end of the project.**

7.2.2. Tasks related to partners

The notification of external business partners (custodian, vPOS provider, SMS confirmation telecommunications provider, fraud prevention provider) **was made at the same time as the users were notified, but this did not imply an immediate termination of the contracts**. The schedule defined in preparation for the closure included a detailed breakdown of when each service would be disconnected from the system.

As new registrations were no longer allowed during the notice period, the deactivation of the related verification and identification functions could be started immediately after the notification. However, due to legal and complaint handling requirements, systems and services related to cash flow (e.g. custody accounts) could only be terminated in one month after closure.

7.2.3. Cooperation of co-departments

During the preparation of the closure, there was close cooperation with the areas within the MNB that were actively involved in the design of the programme. **The implementation of the consensual schedule was monitored through continuous internal communication and weekly**

meetings between the departments, keeping track of the current activities and the progress of the closure.

The communication was done by the Communication and Marketing Department, the wording of the notice was drafted in cooperation with the Legal Directorate. Due to the smooth shutdown of IT systems and the closure of accounts, contacts were particularly intense with two areas, the IT Services Directorate and the Directorate Accounting, Controlling and Procurement.

After the expiry of the notice period, user and transaction data that could continue to be handled by the MNB were also securely backed up and archived so that they can be accessed in the future if necessary (in compliance with data retention requirements).

Finally, the IT systems components were shut down in a predefined sequence and timing, minimising the impact on business operations and ensuring a smooth termination of services.

In order to allow testing of the new features listed in section 9.2 "Further possible directions for improvement", the Student Safe test environment has been maintained.

8. CHALLENGES, EXPERIENCES AND LESSONS LEARNED

8.1. Key challenges in design and development

The development of the Student Safe system raised a number of challenges that are both quite new for a central bank and also a very useful experience for a future, widely deployed central bank digital currency system. The following is a brief summary of the main challenges in designing the system.

8.1.1. Organisational challenges

- One of the key organisational challenges for any system of this complexity is that it **involves many areas of the central bank, whose proper and effective cooperation is essential for successful implementation.** The Student Safe system required close cooperation between the procurement, legal, IT, IT security, monitoring, compliance and customer service areas, while the pilot project was coordinated from a technical point of view by the digitalisation area. Efficient and constructive cooperation enabled the pilot project to be completed in around 16 months (from procurement to the first real transaction).

- A major challenge, both architecturally and organisationally, was the **24/7 availability of the Student Safe system**, which is not common in central banks. In many countries, the interbank transfer system operated by central banks runs only on working days and within a fixed timeframe; relatively few central banks operate a highly complex system on a 24/7

basis[21]. The establishment of 24/7 operation was a significant challenge in respect of the Student Safe, as the MNB's IT systems and the system's vendor support are not operated 24/7. Some of the relevant internal regulations had to be adapted to this, and appropriate procedures had to be developed to deal with problems and complaints received outside official working hours.

- **On the organisational side, new skills and capabilities were required to be obtained** to ensure effective collaboration with external development teams working under an **agile methodology**, and with partner FinTech companies and commercial banks in the development of the Student Safe system, while at the same time ensuring that the new system's operational mechanisms meet central bank and regulatory requirements. The design, monitoring of the whole system and commissioning of its supporting processes required proactive and strong coordination skills.

- In connection with the implementation of the Student Safe system, **the professional internal standards and processes related to the operation of the system had to be developed** (reporting, monitoring, customer service, onboarding, KYC, accounting, notifications, etc.). Central banks typically operate few systems involving direct customer contact, so designing these processes was a significant challenge, but provided a number of very useful lessons. The quality assurance of processes and internal standards was reviewed by an external consultancy company.
- The **investment started as a research and development project**, but with a fixed target date and budget. This created challenges in terms of system design, development, but especially in terms of meeting deadlines, which required constant active supervision of the project.
- **The cooperation between the MNB and Fintech partners presented new challenges that required the adaptability of both parties to successfully address such challenges.** The extremely strict IT security and infrastructure requirements were new expectations for Fintechs operating in market environment, so the preparatory phase required additional resources from both the vendors and the MNB experts who were responsible for communicating and enforcing the requirements. Before going live, security tests validated their implementation.

8.1.2. Architectural challenges

- A significant challenge was **how to integrate a sufficiently isolated and secure system with direct customer connectivity into the IT architecture of the central bank** in a way that was

[21] Although the instant transfer system in Hungary also operates 24/7, it is not operated by the MNB but by its subsidiary GIRO.

sufficiently flexible but also compliant with the relevant security requirements. A particular challenge in the design of the structure was that the MNB could only use cloud services within a very limited framework under Act L of 2013[22], so the design of the system had to be implemented essentially "on-premise", while similar modern systems are increasingly cloud-native. The complexity of the system was also increased by the need to establish the appropriate API (Application Programming Interface) connections with a number of external partners (for more details see 5.2 "Partners involved in the project").

- Although the Student Safe project was essentially implemented as a pilot project, **there was a strong focus on high availability and IT security requirements** from the planning stage on. Ensuring 24/7 operation and high availability – at least 99.5% – was not trivial from an architectural point of view either, but was successfully achieved thanks to the successful cooperation with the external development teams. The appropriate level of IT security of the system was supported by several vulnerability tests and related patches.

8.1.3. Client-side challenges

- **Designing the right UX/UI for a mobile application and its associated system for real end-users is of paramount importance**. In principle, this role is quite new for central banks, as they typically have little or no direct contact with retail customers. Creating high standard customer journeys and customer experience was therefore a significant challenge for the experts at the central bank, but that is why we also used the expertise of external UX/UI specialists to design and fine-tune the system and the mobile application.

- **The development of customer service and customer journeys for new customers' registration and KYC processes was also a significant challenge.** Central banks also have relatively little experience in designing these processes, so creating efficient frameworks and client-side-optimal processes was an exciting challenge. We hired customer service experts with a commercial banking background to develop the proper framework. The experience gained from testing with target group customers prior to the system being launched and the fine-tuning incorporated based on customer service feedback was useful.

8.2. Key lessons learned from the Student Safe pilot project

The design and launch of the Student Safe pilot project provided the central bank with a number of useful lessons. In many areas, the colleagues at the central bank were able to gain hands-on experience related to real use cases and users, which is not really possible in other ways (internal

[22] Act L of 2013 on the electronic information security of state and municipal bodies.

testing, sandbox projects, etc.). In the following sections, we briefly summarise the most important lessons and experiences that may also be relevant in wider international central banking circles.

- **It is worth launching a focused, but cost-effective pilot project involving real users in relation to central bank digital currency before a widespread roll-out:** The MNB gained valuable knowledge in the design, establishment, development and implementation of the architecture of a system with direct customer contact. The experts of the central bank gained in-depth practical experience in areas that are often new to central banks, such as the design and optimisation of direct customer processes, the development of internal rules and regulations related thereto, the design of KYC processes or the coordination of the development of mobile applications. These organisational skills and capabilities are also very useful in case the future large-scale central bank digital currency roll-out is not implemented in a direct customer relationship model, as these experiences are also key to designing and developing the right system in a two-tier central bank digital currency model. This cost-effective pilot project, which involves real customers, provides the central bank with a wealth of feedback that it can successfully incorporate in the next phase.
- **It is important to prepare and train central bank employees in new modern technologies and methodologies:** Before launching the pilot project, it is also worth strengthening the institutional and organisational knowledge of the central bank from a methodological point of view. In the case of the MNB, we organised dedicated training sessions on the challenges of learning and applying design thinking and agile methodologies, as the institutional framework of the central bank does not always support these working and organisational frameworks, but they are very important elements for successful collaboration with innovative actors.
- **Emphasis should be placed on properly assessing customer needs and creating the right customer experience:** In the case of the Student Safe pilot project, we not only used thorough preliminary surveys, but also involved the target group in the prototype testing from the very beginning, and developed the customer interfaces and customer processes with the help of a dedicated team of UX/UI experts. These processes and functions were continuously fine-tuned according to customer needs and feedback.
- **A central bank digital currency pilot project can also provide very useful experience from an operational point of view, while potential risks – due to its pilot nature – can be managed appropriately:** In the context of the Student Safe project, the MNB also gained valuable knowledge in the operation of a system with direct customer contact. The operation of customer service processes, 24/7 operations and the design and operation of monitoring systems are all areas where meaningful experience cannot be gained through internal round testing and sandbox-like frameworks.
- In the case of the Student Safe project, the MNB even gained useful experience in **cybersecurity and fraud prevention** due to the fraudulent behaviour of some users.

However, close monitoring activities starting from registration decreased the possibility of fraud to the minimum.

- **Particular emphasis should be placed on cooperation with market players.** Thanks to the Student Safe pilot project, the central bank gained experience and practice in practical and technological cooperation with commercial banks, FinTech companies, merchant service providers (e.g. online store) and other innovative actors (e.g. in the case of fraud detection). The ecosystem built around the Student Safe initiative is a unique experience for a future, even for wider-scope central bank digital currency roll-outs.

8.3. External tributes

The Student Safe pilot project gained considerable attention not only in Hungary but also internationally. In addition to presentations and information sessions at home, the MNB experts presented their findings at several international forums and joint meetings and workshops with other central banks, where they tried to share their useful experiences with the interested international central banking community.

The **Student Safe project has been officially included as an active pilot project** in the BIS database of central bank digital currency projects[23], in the IMF's study on Central Bank Digital Currency Dissemination Strategies 2024[24], and on the CBDC Tracker[25] website. Since the launch of the Student Safe scheme in 2023, the MNB experts have presented the experience gained from the initiative to more than 20 central banks and international organisations, which we hope will further strengthen cooperation between central banks and provide valuable input to interested central banks.

The **jury of the London-based Central Banking Publications awarded** the **CBDC Initiative Award for 2024**[26] to the MNB Student Safe Initiative, as part of the "FinTech & RegTech Global Awards 2024". The award recognises outstanding innovation and achievements in the development of central bank digital currency.

In addition to active engagement with the central banking community, market participants also recognised the novelty of the initiative. The MNB consulted with several commercial banks and FinTech companies on the initiative, and at the **Mastercard Bank of the Year 2023 competition a**

23 https://www.bis.org/publ/work880.htm

24 https://www.imf.org/-/media/Files/Publications/FTN063/2024/English/FTNEA2024005.ashx

25 https://cbdctracker.org

26 https://www.mnb.hu/en/pressroom/press-releases/press-releases-2024/mnb-s-student-safe-project-receives-cbdc-initiative-award-of-the-year-from-london-based-central-banking-publications

Special Prize was awarded in the category "Financial Solution of the Year for Young People" to the Magyar Nemzeti Bank's youth-focused Student Safe mobile application[27].

9. CONCLUSION AND POTENTIAL DIRECTIONS FOR DEVELOPMENT

9.1. Conclusions

The publication and one and a half years of operation of the Student Safe app clearly shows that the goal set for the central bank has been achieved. By May 2023, the central bank had succeeded in creating a unique mobile application and back-end system using central bank digital currency, accessible to any user in Hungary, which is capable of fulfilling its functional objective of providing a free and secure digital finance application that enables primary school age children and their parents to learn about digital finance in a realistic and yet playful environment.

The creation of the Student Safe programme is the result of the integration of a number of innovative central bank ideas. The main innovative solutions developed by the central bank team behind the Student Safe were the following during the implementation of the project:

- A central bank mobile application and financial services provision for the public were implemented.
- The project was an experimental collection of experiences supported by gamification techniques, which also enabled the development and ongoing maintenance of customer relationships. By creating and operating an active user community, the central bank could provide a secure background for young people to increase their financial literacy, which is not in all cases available from market providers due to potential conflicts of interest.
- FinTech methodologies were applied in project design and delivery, which made the app attractive in both content and design.
- Identification of the legal framework that allows market entry without requiring legislative changes.

The MNB's pilot project involving real users offers a unique experience on the road to widespread adoption of central bank digital currency. Central bank digital currency is, for the time being, a concept that aims to ensure the fundamental role of central banks in issuing money in the digital economy. However, in addition to the issuer and the channel of use, there are a number of options in terms of its main properties and technological parameters, which are being researched worldwide. In this search for a way forward, pilot programmes that can be developed with essentially little effort and short preparation time can play an important role. They are fully functional but operate with a small number of users and openly acknowledge their

27 https://www.mnb.hu/en/pressroom/press-releases/press-releases-2024/the-mnb-student-safe-received-a-special-award-at-mastercard-s-bank-of-the-year-gala

experimentational nature. The experience gained here, whether positive or negative, is very valuable in many ways. On the one hand, they will take central banks along a path they have never been on before, relatively risk-free and without major reputational damage, and for which they can prepare in a practical way through the pilot approach. A functioning digital financial service that serves real customers is very complex, so its implementation involves a lot of novel dilemmas and decisions that central banks can learn about first-hand this way. On the other hand, the daily practice and feedback of thousands of users provide a starting point for continuous development, thinking together with users to ensure that the money of the future is one that serves the goals of both the central bank and users. As consumer needs are constantly evolving and changing, and technology is also evolving at a rapid pace, up-to-date, first-hand knowledge of these will be essential for a truly successful central bank digital currency concept.

With the creation of the Student Safe programme, the MNB has joined the narrow community of central banks who already have real experience regarding a live retail central bank digital currency. More than 94 percent of the world's central banks are actively exploring the potential of central bank digital currency. Many choose and start with one of the possible technologies. While there may be lessons to be learnt here as well, the resources invested do not necessarily bring us closer to the success of a project where we need to build the best possible system for a given well-defined problem, in a way that both the central bank and the users are satisfied. The MNB's "test-and-deploy" approach is a good way to do this. To date, this was the only widely available retail central bank digital currency pilot project in the European Union. In this way, lessons learned and useful experiences for the MNB can be shared not only in Hungary, but also in the wider central banking community. In bilateral meetings or at broader knowledge-sharing forums and conferences, dozens of central banks have already explored the idea, its main functionalities and experiences, and have been inspired to perform further research.

9.2. Other possible directions for development

As a retail financial mobile application, Student Safe could theoretically be extended with several additional features. The features of the Student Safe, which were implemented until the end of 2024, can be easily extended thanks to the modular architecture of the backend system. These upgrades can both provide additional options for users and give them the opportunity to try out new technologies. The possible directions for further development identified so far are:

- **Offline payments:** implementing digital payments without an internet connection would add a functionality to the app that is not yet available in real-world conditions, which could provide users with a similar flexibility as cash payments. Internet access scarcity can be a real problem for 8-14 year olds, but also for anyone else, so extending the Student Safe in this way could expand the MNB's experience in this area of also global interest by meeting a real consumer need.

- **Virtual card issuance:** the application currently allows QR code and transfer payment solutions. Users' choice could be increased if the digital payment solution mostly known and used by merchants today, card payment, could also be made available through a virtual card built into the app. This could essentially increase the user base.

- **Banking integration:** integrating the mobile app into commercial banking apps could further expand the user base, while supporting digital financial inclusion for the relatives of commercial banking customers. In addition, it could also be a platform for technological testing of the integration of a central bank application into commercial banking applications, which could test the implementation of the so-called hybrid CBDC operating model, the currently dominant form of central bank-commercial bank cooperation in the world.

- **Buying government bonds:** to further increase financial awareness, savings targets should include not only commodities that can be bought later, but also long-term investment opportunities. Among these, the possibility of buying government bonds without repayment risk, which is of key importance in financing the domestic economy, could be created as a first step.

- **Programmability:** the added value of central bank digital currency could be an additional function that would make targeted payments feasible. Programmable payment options may be basically used to place targeted public subsidies quickly and efficiently, but for the young people who are the current user base of the Student Safe, there are also specific goals or life situations where programmable payments can play a role, for example by promoting sustainability goals.

During the almost two years of operation of the Student Safe, we have achieved our goals. Until further priorities are set, the public operation of the system will be suspended. The central bank will examine the possible motivations and emerging use cases that could be relevant to the Student Safe user base or to another group of consumers as the next step on the path to the money of the future.