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Digital Innovation and Circular Economy in Islamic Basic Education: The IFDS-e M Model at SD Aisyiyah Gemolong

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ABSTRACT

Purpose – This study investigates the implementation of Integrated Financial Digital Services and e-Money (IFDS-e M) as an innovation strategy to pioneer a circular school model at SD Aisyiyah Gemolong. It addresses Indonesia's ecological crisis and unsustainable consumption patterns by combining digital transformation with circular economy principles in basic education.

Design/methods/approach – Using a descriptive qualitative case study, the research was conducted at SD Aisyiyah Gemolong, a high-performing elementary school with 1,030 students in Central Java. Data were collected through participatory observation, in-depth interviews, documentation, and questionnaires. Data analysis employed the Miles and Huberman model to interpret emerging patterns and evaluate program impact.

Findings – The IFDS-e M system successfully digitized school transactions, reduced the use of cash, and shaped environmentally conscious behaviors among students. The ban on pocket money led to a measurable reduction in food packaging waste, while school-owned enterprises (BUMS) enhanced service efficiency and internal resource circulation. Over 95% of school financial transactions were processed digitally, improving transparency and minimizing paper use. Challenges such as intermittent internet connectivity emerged during peak access times but did not hinder overall program outcomes.

Research implications – The IFDS-e M model offers a replicable strategy for schools to advance sustainable behavior and reduce environmental impact. It informs educational policy and practice on integrating digital tools with ecological values to cultivate responsible consumption from an early age.

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1. Introduction

A lot of data shows that the earth as a place of life for all creatures is currently experiencing an ecological crisis (Poceratu, 2021; Siswantara et al., 2022). One of the causes is related to waste, and Indonesia is a central part of that cause (Aisha, 2023). Data from The Economist Intelligence Unit states that Indonesia is the second-largest producer of food waste in the world, and Indonesia is one of the world's second-largest contributors of plastic waste after China. Indonesia produces around 3.22 million tons per year with waste dumped into the sea reaching 0.48-1.29 metric tons per year (World Bank, 2018). This condition will worsen if not addressed immediately. Most people are already trapped in a lifestyle characterized by practicality, fast and instant. These characteristics are proof of how dominant the linear economic pattern is take-make-dispose (take–make–throw away) (Burke et al., 2023; Dinda, 2020). A characteristic linear economic pattern take–make–dispose has long dominated global production and consumption systems. This model not only relies on the unfettered exploitation of natural resources, but also ignores ecological sustainability and long-term impacts on the environment (Cate, 2025; Unlu, 2025). The consequences are the accumulation of waste, environmental degradation, and

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increased carbon emissions. Therefore, a number of studies affirm the urgency of a paradigm shift towards a circular economy as a systemic solution to the ecological crisis.

On the other hand, the rapid development of technology has made the current demands in every field of life a digital era. This requires humans to switch from manual systems to digital systems in daily life. Digitalization itself is carried out in order to increase efficiency and effectiveness of performance, so that time and all resources owned can be processed as optimally and effectively as possible. One of them is digitalization in the field of Education (Indriati & Supardal, 2023).

In this case, the emergence of the concept of a circular economy that is optimized with the use of digital services from technological developments brings a breath of fresh air because it offers an alternative systemic solution to the waste problem. Meanwhile, the main challenge in implementing the circular economy with this technology is a change in mindset community. This is a new model in the flow of production and consumption intended to prevent the use of non-renewable natural resources and the emergence of waste (Asrul et al., 2023; Darmastuti et al., 2021). The world of education is seen as having a strategic role in efforts to change the mindset of the community, the reason is that through the world of education, the conception of the circular economy and digitalization, can be introduced early, especially since children today are the generation that cannot be separated from technology (Junfithrana, 2023; Kristianto et al., 2022; Tambunan et al., 2023).

Therefore, through the IFDS-e M (Integrated Financial Digital Services and e-Money) innovation design to pioneer a circullar school at SD Aisyiyah Gemolong, through the world of education, the author wants to be able to build a commitment by applying circular patterns in daily life starting from school, to the home environment, then in a wider environment from an early age. So that natural issues with the alternative conception of the Circular Economy with digitalization optimization that not many people know can be more widely known and then applied. Especially starting from SD Aisyiyah which has a number of more than 1,000 students, increasing with their parents, families, neighbors and the community in general so that it is hoped that it will have more impact on the preservation of nature and future generations.

The purpose of writing this school service innovation aims to find out the concept of IFDS-e M (Integrated Financial Digital Services and e-Money) to pioneer a circullar school at SD Aisyiyah Gemolong, and to know the process of implementing and implementing IFDS-e M (Integrated Financial Digital Services and e-Money) to pioneer a circullar school at SD Aisyiyah Gemolong.

2. Methods

This study uses a descriptive qualitative approach with a case study method. This approach was chosen to comprehensively describe how the Integrated Financial Digital Service (IFDS-e M) system and e-Money are implemented as part of the transformation towards a circular school at SD Aisyiyah Gemolong. The qualitative approach allows researchers to understand the meanings contained in complex social phenomena through the perspective of participants in depth. Thus, this study emphasizes understanding the local context and social dynamics that occur in the application of digital-based and environmentally sound innovations in the elementary school environment (Creswell & Clark, 2018).

The location of the study is SD Aisyiyah Gemolong, Sragen Regency, Central Java, which has more than 1,000 students and has been known as a driving school with a high rate of technology adoption. Subjects in this study include school principals, teachers, students, parents, and external partners such as e-Money service providers and school business units. The selection of subjects was carried out purposively, taking into account their direct involvement in the IFDS-e M program.

The data collection technique was carried out through participatory observation of the digital service process and student activities related to the circular economy, in-depth interviews with parties

actively involved, as well as documentation of digital transaction data, school financial reports, and socialization materials for the circular school program. In addition, a questionnaire was also used to obtain supporting quantitative information, such as user satisfaction levels and the environmental impact of the cashless school policy. This combination of techniques is used to strengthen the validity of the data through triangulation of sources and methods (Moleong, 2016).

Data analysis was carried out using the Miles and Huberman interactive model (Miles et al., 2020), which consists of three main stages, namely data reduction, data presentation, and conclusion drawn. Data reduction is carried out by filtering important information from the results of interviews and observations. The reduced data is then presented in narrative and thematic form, before finally being concluded based on patterns and relationships between findings. The validity of the data is maintained through triangulation techniques, member checking with respondents, and peer debriefing.

The implementation of the research is divided into several stages. The first stage is the planning and preparation of the IFDS-e M innovation design. The next stage is the socialization of the circular school concept and digitalization system to all stakeholders, including teachers, students, parents, and the community around the school. Furthermore, the implementation of the e-Money system and the digitization of school services are carried out as a whole. After implementation, monitoring and evaluation of the effectiveness of the program as well as changes in environmental and digital behavior of the school community are carried out. The final stage is the reporting of results and the preparation of recommendations for sustainable development. All of these stages aim to support the achievement of sustainable circular economy principles, such as reduce, reuse, and recycle (Ellen MacArthur Foundation, 2022).

With this method, it is hoped that a comprehensive picture can be obtained of the effectiveness of IFDS-e M in supporting digital transformation and a sustainable environment in the basic education sector.

3. Results

3.1. Method of Implementing Integrated Financial Digitalization Services (IFDS-e M) to pioneer circullar schools at SD Aisyiyah Gemolong

SD Aisyiyah Gemolong, was established in 2004 with the motto: Islamic and Achievement. The location is located in Gandurejo, RT 05B Gemolong, Sragen Regency, Central Java. The school stands on an area of about 4,850 m2. In the 2023/2024 school year, the school, which is accredited A (Excellent) by BAN S/M with a score of 97 in 2023 (scale of 100), has 1,030 students, consisting of 32 study groups (classes) and 97 teachers/employees. With such a large number of students, SD Aisyiyah Gemolong has a considerable potential opportunity and obligation to play a role in efforts to save the earth. This is done by instilling a circular economy mindset by being optimized with technology.

This effort was initially sparked by the school's participation in the activity held on January 20-22, 2022 by the Center for World Trade Studies of Gajah Mada University (PSPD UGM), WTO Chairs Programme and JBI Education Consulting at the Center for Agro Technology Innovation (PIAT) UGM Yogyakarta. In this activity, it added to the school's enthusiasm to further understand and implement circular economy innovations through the circular school program under the guidance of PSPD UGM. Several activity plans in the circular school program have been prepared. Most of them have been implemented by SDAUG. The details are as follows.

a. Intensely and detailed socialization of the concept of circular schools to the big family of SD Aisyiyah Gemolong

b. Pioneering the Integrated Financial Digitalization Service (PDKT) system in the school financial system.

One of the goals is to provide convenience to parents/guardians of students in making school payments and transactions, namely being able to make transactions anytime and anywhere through an application on a mobile phone.

c. Procurement e – Money SD Aisyiyah Gemolong

Prohibiting students from carrying pocket money or cash at school, and channeling the use of student money at school through SDAUG e-money. Cash or pocket money that is found to be brought by the student will be requested by the teacher, and it can only be collected by the student's parents/guardians.

This policy indirectly prevents students from transacting outside of school. Because, along the way to and from school until returning home, students cannot make transactions to buy food and drink outside of school. As a consequence, the school prepares food commodities for students, namely snacks during the first break and lunch during the second break with food that is more guaranteed in terms of nutrition, hygiene and health.

d. Developing other programs that are rooted in the concept of Circullar School and the use of digitization-based services.

e. Carry out efficiency and optimization, especially on things that are continuously needed to meet the needs of students and needs in learning activities. The real form is to try to meet all these needs independently through school business units that are members of School-Owned Enterprises (BUMS). Some examples are in (a) the procurement of snacks and lunches; (b) meeting learning needs; (c) psychological consultation; (d) fulfillment of the need for any type of outbound travel.

3.2. Design of the Integrated Financial Digitalization Service Model (IFDS-e M) to Pioneer a Circullar School at SD Aisyiyah Gemolong

The flagship Aisyiyah elementary school has 1,030 students. This requires that all services must be carried out as effectively and efficiently as possible. The only solution is to utilize technology and digitalization. The practice of digitization at SD Aisyiyah Unggulan Gemolong can be obtained from various services.

Through the innovation of IFDS-e M (Integrated Financial Digital Services and e-Money) to pioneer a circullar school at SD Aisyiyah Gemolong. It is hoped that both the waste problem and the integrated service that is fast and easy can be realized together.

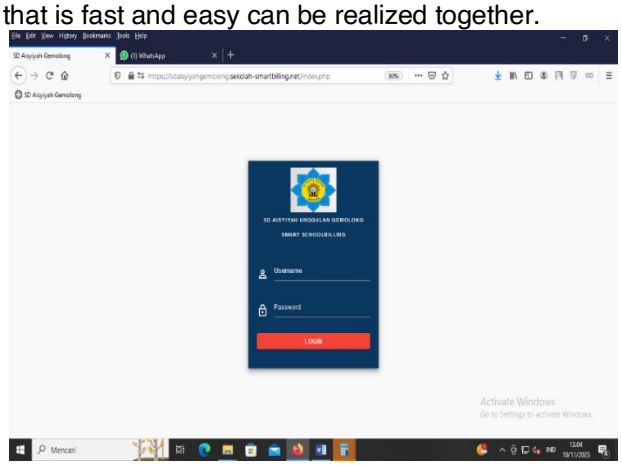

Figure 1. Home Page on the TU school computer server

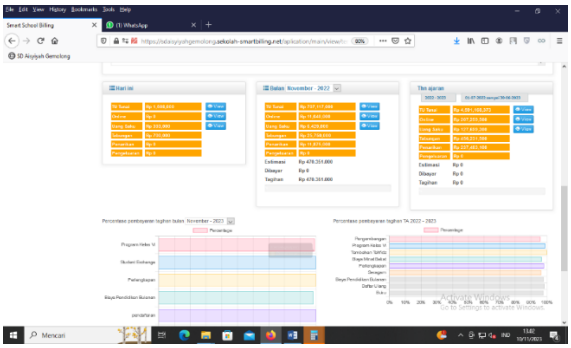

Figure 2. Pages that show in a short time can be displayed financial recapitulation data in a detailed way as a tool for taking a school policy

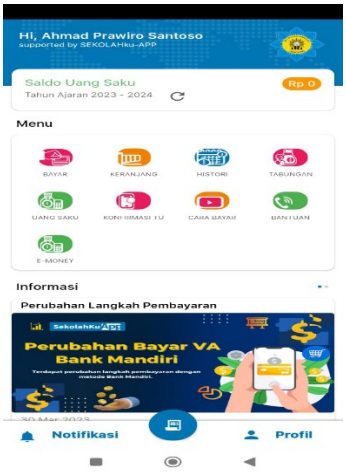

Figure 3. The page that is seen on the screen of the Parent/Guardian Cellphone that allows only through the cellphone can do various payment features without having to come to school.

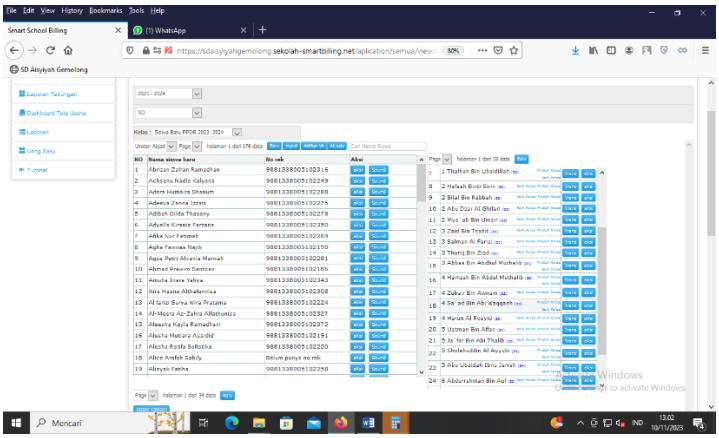

Figure 4. Pages that show in a short time can be displayed student data that reaches more than 1,000 students in a short time

Figure 5. The physical appearance of e-money; as a physical student card and functionally as the only digital means of payment at SD Aiysiyah Gemolong

Figure 6. Appearance of the use of e-money in schools

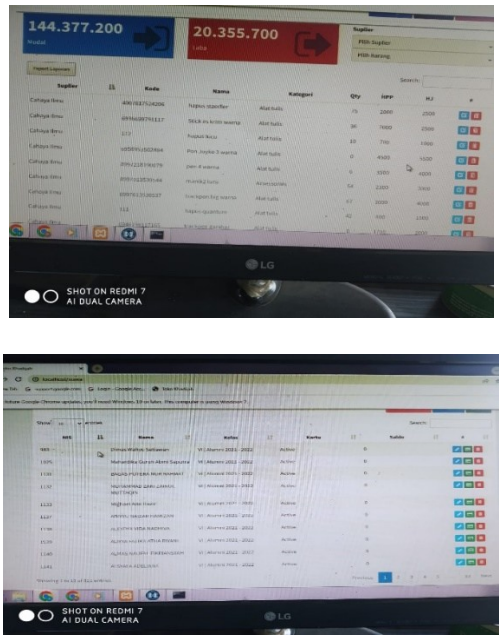

Figure 7. Appearance of pages on computer servers in the use of e money

3.3. Functional Analysis and How Integrated Financial Digitalization Services (IFDS-e M) Work to Pioneer Circullar School at SD Aisyiyah Gemolong

Awareness and understanding of the concept of the circular economy, as well as its implementation through the circular school program at SD Aisyiyah Gemolong by maximizing integrated digitalization services is expected to become social capital for every student and Parents/Guardians to play a role as an agent of change in cultivating a circular lifestyle, and can be transmitted to other parties. In addition, the circular culture embedded in students is expected

to become a sustainable lifestyle when students take education to a higher level, when they are adults, already working, having families, and can be transmitted to the next generation.

The solution to this problem, of course, is to change the mindset of society from a linear economic system that tends to Squirt to the circular economy system, a new model in the flow of production and consumption intended to prevent the use of new natural resources and the emergence of waste. Circular economy is intended as a framework of systemic solutions that are deliberately designed restoratively and regeneratively to address global challenges such as climate change, biodiversity loss, waste, and pollution (Ellen MacArthur Foundation, 2022).

This is also in line with the development of technology today which requires humans to switch from manual systems to digital systems. The digitalization phenomenon makes a person required to maximize the use of digital technology in daily life. Digitalization itself is carried out in order to improve the efficiency and effectiveness of the performance of each part of the industry, so that time and all resources owned can be processed as optimally as possible to get the maximum profit. Many technologies continue to evolve in a better direction or in the direction of automation.

This also makes the development of the digital era possible in every field. One of them is digitalization in the education sector. Education is the third backbone after health and the economy, so traditional education must be able to respond to the latest challenges.

Some of the activity plans in the Integrated Financial Digitalization Service (IFDS-e M) implementation program to pioneer a circullar school at SD Aisyiyah Gemolong, the details are as follows

a. Socialization of the concept of circular schools intensely and in detail to the big family of SD Aisyiyah Gemolong in the following ways;
    1) Socialization to Teachers and Employees: namely an effort to equalize the understanding and vision of circular schools from teachers and employees as the front line in the implementation of circular school programs. The role of teachers and employees is also related to the selection of SD Aisyiyah Gemolong as one of the elementary schools selected by the Ministry of Education and Culture of the Republic of Indonesia as the first batch of Driving Schools in 2021. Driving School is a school that focuses on developing student learning outcomes holistically by realizing the Pancasila Student Profile which includes competencies and characters that begin with superior human resources (Principals and Teachers). As a Driving School, SD Aisyiyah Gemolong runs an independent curriculum by allocating 20% of learning to be project-based. In such project-based learning, the concept of the circular economy is integrated into the curriculum and innovation of school activity programs. This step may seem small and simple but it is very strategic for schools to initiate change.
    2) Socialization to students regarding the purpose and urgency of circular schools.
    3) Socialization to parents/guardians of students and school committees regarding the purpose and urgency of circular schools. This socialization was carried out in a parent/guardian meeting forum and through an official notification.
    4) Socialization to the community in general, especially in the school environment, related to the purpose and urgency of circular schools. This socialization is carried out through podcasts, videos, information on social media or other media.
b. Pioneering the Integrated Financial Digitalization Service (PDKT) system in the school financial system.

    One of the goals is to provide convenience to parents/guardians of students in making school payments and transactions, namely being able to make transactions anytime and anywhere through an application on a mobile phone. The application can be downloaded for

free through the playstore. In addition to making payments for school financial administration, this digitization system also makes it easier for parents/guardians of students to access the latest notifications and information from the school, communicate with the TU or school, save, pay zakat, infaq, alms, check financial transaction history. As is the case with students, this digitalization system will reduce the burden on parents' mobility to school, both in terms of time allocation, energy, fuel oil (BBM) consumption, and transaction activities throughout the student's journey (leaving, returning, and returning home) because everything can be done from home.

c. Procurement e – Money SD Aisyiyah Gemolong
   1) Prohibiting students from carrying pocket money or cash at school, and channeling the use of student money at school through SDAUG e-money. Cash or pocket money that is found to be brought by the student will be requested by the teacher, and it can only be collected by the student's parents/guardians.
   2) This policy indirectly prevents students from transacting outside of school. Because, along the way to and from school until returning home, students cannot make transactions to buy food and drink outside of school. As a consequence, the school prepares food commodities for students, namely snacks during the first break and lunch during the second break with food that is more guaranteed in terms of nutrition, hygiene and health. This policy also applies to the purchase of learning needs, such as books, pencils, and so on that have been sold at school-owned stores.
   3) The effect of the above policy also prevents students from snacking carelessly outside of school, while reducing waste production in schools. Out-of-school snack services generally correlate with packaging that simply ends up as garbage, especially plastic waste. With more than 1,000 students, you can imagine the amount of waste that can be avoided through the digitization of money in the form of e-money.
   4) SDAUG e-money is treated as the only means of payment for students and is physically treated as a student identity card (student student card) which effectively and efficiently stores all students' personal data. For this reason, students no longer need another identity card.
   5) To support transactions through SDAUG e-money, the school collaborates with two partners who are ready to collaborate, namely "TokoMu" and the restaurant "Ayam Sako Gemolong"

d. Developing other programs that adhere to the concept of Circular School and the use of digitization-based services, including the following;
   1) Starting the use of non-disposable drinking places (as well as prohibiting the use of disposable drinking bottles and eating places) in the SDAUG environment, including during learning and school activities.
   2) School information is no longer conveyed through paper (in the form of a print out), but is transferred through digital messages (online) by utilizing social media application services, such as Whatsapp. With more than 1,000 students, this policy can save the need for paper, at least two rhymes of paper (1,000 sheets) for each submission of school information to students or parents/guardians.
   3) Plan to use leftover food from snacks and lunches to be recycled so that it does not end up as waste. This method is done through collaboration with several parties who routinely use leftovers as livestock feed and fertilizer making. Occasionally, if the amount of leftover food ingredients is abundant, it will be processed into other food ingredients such as crackers.
   4) Setting product standards in the planning and updating of facilities and infrastructure with good product quality and longer service life. For example, they do not use wooden tables and chairs.

5) Minimizing the purchase of new facilities and infrastructure, namely by optimizing repairs if the goods are damaged; and or change and utilize damaged goods to be reprocessed into other goods needed.
6) The use of school land for productive plants as well as a learning material for students to plant various types of plants.
7) Make a student waste alms program on a scheduled basis. Each student is asked to bring plastic bottle waste at home and its surroundings to be distributed to collectors for later recycling.
8) Designing project-based learning as a form of learning in the independent curriculum for driving schools with works with circular economy concepts. For example, ecobricks, ecoprints, collages and handicrafts from second-hand goods. The students' work in the learning project, along with other learning outcomes and a number of student attractions, will be displayed in the "Panen Karya" event held in one of the malls in the city of Solo. In this way, it is expected that the students will be more motivated in learning and experimenting, as well as enthusiastic about having exciting new experiences when running the circular school program.

Figure 8. Harvest of Circular School Works of SD Aisyiyah in Solo Grand Mall

9) Carry out efficiency and optimization, especially on things that are continuously needed to meet the needs of students and needs in learning activities. The real form is to try to meet all these needs independently through school business units that are members of School-Owned Enterprises (BUMS). Some examples are in (a) the procurement of snacks and lunches; (b) meeting learning needs; (c) psychological consultation; (d) fulfillment of the need for any type of outbound travel. Until the 2022/2023 school year, the fulfillment of the needs of the school independently is as follows.
   a) Procurement of snacks and lunches for students, teachers, and employees through a school kitchen called Catering Fatimah;
   b) Psychological consultation was carried out through the Aisyar psychology service bureau owned by SD Aisyiyah Gemolong;
   c) The fulfillment of office stationery, the needs and materials of teaching and learning activities, and daily basic needs is carried out through the Khodijah Shop. This store with a minimarket concept even serves public needs;
   d) The fulfillment of uniforms, school attributes and Muhammadiyah associations is fulfilled through the branch shop of Suara Muhammadiyah at SD Aisyiyah Gemolong;
   e) Establishing a photocopying business;
   f) Independent production of modules and textbooks;
   g) The existence of an internal travel agency for tourism and other outgoing activities;

h) The establishment of the Ayam Sako Gemolong restaurant;
i) Student shuttle service;
j) Procurement of sharia credit to help the needs of school residents.

Some of the BUMS above are even to meet general needs. This means that the general public can take advantage of SDAUG's businesses even with slightly different prices/costs. Through the BMUS, in addition to reducing costs and minimizing waste, some of the profits can also be allocated to help ease school financing for students who need it.

Broadly speaking, the positive impact of BUMS can be extracted as follows;

a) When compared to involving a third party, the costs incurred through BUMS become more efficient, in accordance with the expectations of the school, and the profits can belong to the school.
b) If there are problems such as complaints from students or parents/guardians, handling and solutions can be done faster and more freely. This is because the implementation of BUMS is under the direct coordination of the school;
c) School needs become more planned and their fulfillment can be adjusted to the needs and abilities of the school;
d) Meeting the needs of schools can run more effectively and efficiently;
e) There is additional income from BUMS profit sharing that can be used to increase school activities whose financing no longer relies on assistance from the government;
f) Additional income from BUMS profit sharing can also be used to increase the welfare of teachers and employees. Some of the activities and services to improve the welfare of teachers and employees include:
   (1) Umrah program for teachers and employees every year;
   (2) Interest-free and unsecured money lending services to teachers and employees;
   (3) Distribution of basic necessities once every 3 (three) months to teachers and employees;
   (4) The existence of a pension fund for teachers and employees;
g) The increase in welfare encourages teachers and employees to improve their professionalism according to their respective fields of work;
h) Increasing the professionalism of teachers and employees has an impact on better quality learning assistance for students and encourages student achievement to be even better.

3.4. Implementation Plan

IFDS-e M (Integrated Financial Digital Services and e-Money) to pioneer circullar school at SD Aisyiyah Gemolong as one of the solutions to this problem, of course, must begin by changing the mindset of the community from a linear economic system that tends to Squirt to the circular economy system, a new model in the flow of production and consumption intended to prevent the use of new natural resources and the emergence of waste. Circular economy is intended as a framework of systemic solutions that are deliberately designed restoratively and regeneratively to address global challenges such as climate change, biodiversity loss, waste, and pollution (Ellen MacArthur Foundation, 2022).

There are several characteristics of the circular economy that have been widely agreed. First, the circular economy is a closed-loop system aimed at extending the "life" of products and preventing the occurrence of waste. Second, there is a 'design-to-redesign' thinking that emphasizes the importance of designing goods whose products can eventually be processed or reused in order to redesign the economic system. Third, there is a multi-level approach to achieve fundamental changes in the economic system with the target of achieving economic prosperity that is in line with environmental and social aspects. In addition to these characteristics, there are a

number of principles that are highly recommended to maximize the use of the product as long as possible, such as reuse; repair; maintaining the value of goods through the recycling process; recovery; and minimize the use of new raw materials (reduce).

This effort was initially sparked by the participation of the Principal of SD Aisyiyah Gemolong in an activity organized on January 20-22, 2022 by the Center for World Trade Studies of Gajah Mada University (PSPD UGM), WTO Chairs Programme and JBI Education Consulting at PIAT UGM Yogyakarta. In this activity, it added to the school's enthusiasm to further understand and implement circular economy innovations through the circular school program under the guidance of PSPD UGM. Several stages of activities in the implementation of IFDS-e M (Integrated Financial Digital Services and e-Money) innovations to pioneer circullar schools at SD Aisyiyah Gemolong have been arranged as follows;

Table 1. Stages of activities in the implementation of IFDS-e M (Integrated Financial Digital Services and e-Money) innovations to pioneer circullar schools at SD Aisyiyah Gemolong

No	Types of Activities	Month 2024				Person in Charge
		1	2	3	4	
1	Evaluation of Programs that Are Already Running	✓				The principal with all the vice-principals
2	Preparation of recommendations for improvement programs	✓				The principal with all the vice-principals
3	Determination and MoUs of third-party partners in application refinement	✓	✓			Principal
4	Program discussion and funding		✓			The principal with all the vice-principals
5	Program Socialization		✓			Principal, School Treasurer and Student Affairs Officer
6	Program Trials		✓	✓		The principal with all the vice-principals
7	Program Evaluation			✓		The principal with all the vice-principals
8	Program Implementation			✓	✓	The principal with all the vice-principals
9	Report Generation				✓	School Principal and School Treasurer

The video on the school's official Youtube account, with the name of the SD Aiyiyah Uggulan account with the title IFDS-e M (Integrated Financial Digital Services and e-Money), withthe following link: https://youtu.be/BWxdfq9s9_w?si=Ykt9cPMSSs5VUPEV

The implementation of Integrated Financial Digitalization Services (IFDS-e M) to pioneer a circular school at SD Aisyiyah Gemolong began with awareness of the importance of the school's role in protecting the environment by instilling technology-based circular economy principles. With the number of students reaching 1,030 people, digitization of services is an effective solution for financial management and change in consumption behavior. (Nitimanta et al., 2023)

This program was triggered by SD Aisyiyah's participation in circular economy training activities at PIAT UGM, which then encouraged the school to develop digitalization-based innovations. The socialization of the circular school concept is carried out intensely to teachers, students, parents, and the surrounding community. This socialization aims to equalize understanding of the importance of changing from linear economic patterns to digital-based circular economy (Jayawati et al., 2020; Sitompul, 2023).

The implementation of IFDS-e M is shown by the use of digital applications for school financial transactions that can be accessed via mobile phones, making it easier for parents to make

payments without having to come to school. In addition, SD Aisyiyah Gemolong e-Money is issued for all students, replacing cash in the school environment. With this policy, students are not allowed to carry cash, which has an impact on reducing impulsive consumption behavior outside of school and contributing to the reduction of plastic waste from food packaging. (Annisa Nur Salam, 2020; Minsih et al., 2021; Munawan & Rifki Priatna, 2023) The results of his research show that: a) the use of the e-money tab as an attendance tracker can only be accessed in schools and requires a strong internet network, b) the advantage of using the e-money tab as an attendance tracker is that it can track student attendance easily, allowing teachers to ensure discipline and parents to monitor the arrival and departure times of their children to and from school. On the other hand, the disadvantage of this system is the instability of the internet network especially when many students use the e-money tab at the same time, causing errors on the server, c) the e-money tab has had an impact on the attendance tracking process, where it has maintained and improved the discipline of the students.

Another related innovation is the strengthening of school business units (BUMS) that serve internal needs such as school catering, stationery stores, travel agencies, and even psychological services. With the existence of BUMS, schools have succeeded in meeting many internal needs independently, reducing costs, reducing dependence on third parties, and improving the welfare of teachers and employees through profit sharing. In other conditions, studies revealed that the average weight of plate waste per school child reached 178 g, and the total weight of plate waste accounted for 28.75% of the total weight of the food served (Chu et al., 2023; Sundin et al., 2023). No significant differences were found in the weight of dish waste between different age groups and classes of schoolchildren, which was also confirmed by the one-way ANOVA test. An analysis of dish waste by food category shows that beverages account for the largest share of total dish waste (42.24%), followed by staples (28.38%) and meat (11.77%). Analysis of the share of food plate waste served (%) by food category reveals the same situation: the largest share of food served consists of beverages (37.56%), followed by staple foods (36.48%) and meat (28.77%). Analysis of the monetary value of food waste shows that the average cost of dish waste (excluding beverages) per school child is EUR 0.236, which represents 16.6% of national and municipal funding of EUR 1.42 per serving. Given the results of the study, the authors have concluded that in order to reduce the amount of plate waste generated by the schools of the city of Rezekne, the school menu should be based not only on the requirements determined by the relevant legal acts but also on the cooking process that meets the needs of modern consumers (students), for example, by following the trend of cooking practices in the community to make students interested in consuming school meals. This gap also needs to be considered to solve the occurrence of waste due to catering.

The practice of circular schools is also seen in several programs such as the use of non-disposable food and beverage containers, food waste processing, optimization of the use of digital media for communication, to student projects based on recycling and sustainability. The "waste alms" program and the use of school gardens for learning activities are concrete examples of the internalization of circular economy values in students' daily lives. All of these efforts are designed to form a circular living culture from an early age, as well as integrate the use of digital technology to support efficiency, sustainability, and character education at SD Aisyiyah Gemolong.

The findings of the study show that the implementation of Integrated Financial Digitalization Services (IFDS-e M) at SD Aisyiyah Gemolong not only functions as a means of payment, but also as a circular economy-based character education strategy. This approach shows that digital transformation in the primary education sector has great potential to drive more environmentally friendly changes in consumption behavior.

First, the implementation of e-Money and the ban on carrying cash in schools have succeeded in forming healthy consumption habits and reducing the production of plastic waste. This is evident in the policy that prohibits students from carrying cash and requires transactions only through school e-money:

> "Prohibiting students from carrying pocket money or cash at school, and channeling the use of student money at school through SDAUG e-money".

This policy not only prevents the consumption of unhealthy foods outside of school, but also strengthens control over student consumption, while instilling the value of reduce in the principles of the circular economy.

Second, the strategy of digitizing school services with digital financial applications facilitates transactions for parents/guardians of students without having to come to school, while reducing the use of fuel and paper. This efficiency provides added value in terms of environment and comfort:

> "In addition to making payments for school financial administration, this digitization system also makes it easier for parents/guardians of students to access the latest notifications and information from the school, communicate with the TU or school, save, pay zakat, infaq, alms, check financial transaction history".

In the context of sustainability, this step shows the contribution of digitalization in reducing the carbon footprint of student families.

Third, schools also develop school business units (BUMS) as a form of internal circular economy sustainability, where production and consumption are managed independently and responsibly. Businesses such as Fatimah Catering, Khodijah Shop, and in-house travel agencies not only meet the needs of schools, but also increase income that can be used for teacher and student welfare programs:

> “When compared to involving third parties, the costs incurred through BUMS become more efficient, in accordance with the expectations of the school, and the profits can belong to the school".

This concept is in line with the principle of reuse and recycle in the circular economy, where economic value continues to revolve within the school ecosystem itself.

Fourth, waste management programs such as waste alms and the use of food waste emphasize integrative efforts in building a circular living culture among students. The processing of food waste into animal feed or fertilizer materials, as well as the manufacture of products from used goods (ecobricks, ecoprints) in learning projects, are concrete forms of:

> “Make a scheduled waste alms student program" and "Plan the use of leftover foodstuffs from snacks and lunches for recycling”.

Through this approach, students not only learn about the circular economy in theory, but also put it into practice in their daily activities.

4. Discussion

This study aimed to explore the concept and implementation of the Integrated Financial Digital Services and e-Money (IFDS-e M) as a strategy to pioneer a circular school at SD Aisyiyah Gemolong. The findings confirm that the adoption of IFDS-e M significantly supports shifts in consumption behavior, enhances service efficiency, and internalizes circular economy values through digital means. These outcomes directly address the research objectives by demonstrating how digital financial services can become a strategic tool in fostering a sustainable lifestyle within the primary education setting.

The implementation of IFDS-e M has proven to positively influence both financial management and environmental behavior. The school’s policy of banning cash and mandating all transactions via e-money has not only streamlined financial processes but also reduced waste from external food packaging. Moreover, digital applications have enabled parents to make payments and access school

information remotely, contributing to reduced carbon footprints and resource savings. This illustrates the practical embodiment of reduce and reuse principles within the school's ecosystem.

These results align with the framework of circular economy as a restorative and regenerative system to address global challenges (Ellen MacArthur Foundation, 2022). The behavioral changes in student consumption—enabled by e-money—also support the potential of school interventions to reduce food and packaging waste (Chu et al., 2023; Sundin et al., 2023).

In contrast to more conventional outsourcing models, the development of internal school enterprises (BUMS) at SD Aisyiyah represents a distinctive model of resource independence and internal circulation, which extends earlier models of school-based innovation (Jayawati et al., 2020). However, challenges such as unstable internet connections, particularly during peak usage periods, reflect infrastructural limitations in digital transformation within education (Minsih et al., 2021).

This research extends the theoretical discourse on the circular economy by positioning schools not only as knowledge transmitters but also as agents of socio-environmental transformation. By integrating digital systems into the everyday routines of students and families, the IFDS-e M model offers a micro-level application of the design-to-redesign and closed-loop principles in the circular economy. Furthermore, it demonstrates how schools can operationalize sustainable production and consumption systems within their institutional boundaries, thus contributing to a broader theory of sustainable education practices.

From a practical standpoint, the IFDS-e M model presents a scalable strategy for other schools to emulate. Key recommendations include:

a. Digitalizing School Transactions: Implement e-money systems to prevent impulsive consumption and promote financial transparency.
b. Developing Internal School Enterprises (BUMS): Establish in-house services (e.g., catering, school stores, travel units) to enhance self-sufficiency and reduce third-party dependence.
c. Curricular Integration: Embed circular economy projects (e.g., ecobricks, recycled crafts) into project-based learning to instill sustainability values early.
d. Community Engagement: Conduct thorough socialization efforts targeting teachers, students, parents, and the wider community to shift mindsets from linear to circular models.

While the findings provide valuable insights, this study has several limitations. First, its single-case qualitative approach may limit the generalizability to schools with different socio-economic or infrastructural contexts. Second, the effectiveness of IFDS-e M is partly constrained by technical limitations such as internet instability during high-traffic usage. Lastly, a lack of long-term quantitative evaluation means the environmental impacts of the program remain partly anecdotal.

Future research is recommended to:

a. Conduct quantitative assessments of environmental outcomes (e.g., reduction in waste, emissions, paper usage).
b. Compare multiple schools that have and have not adopted similar systems to determine effectiveness across contexts.
c. Examine long-term behavioral changes in students and families resulting from exposure to circular economy practices.
d. Explore the adaptability of IFDS-e M in schools with limited digital infrastructure to assess broader implementation potential.

In conclusion, the IFDS-e M initiative at SD Aisyiyah Gemolong presents a pioneering model of digital innovation aligned with circular economy principles in primary education. The initiative not only improves administrative efficiency and student welfare but also cultivates an early awareness of sustainable living practices. The primary contribution of this research lies in demonstrating how digital

transformation, when integrated with circular values, can reposition schools as strategic agents in advancing environmental sustainability, behavioral change, and community-based innovation.

5. Conclusion

This study demonstrates that the implementation of Integrated Financial Digital Services and e-Money (IFDS-e M) at SD Aisyiyah Gemolong functions not only as a digital financial system but also as an effective vehicle for shaping environmentally responsible consumption behaviors and embedding circular economy values from an early age. By prohibiting the use of cash and mandating all transactions via e-money, the school has succeeded in reducing external consumption waste, improving internal logistics, and reinforcing governance grounded in the reduce, reuse, recycleprinciples.

The model further illustrates how digitalization can enhance the efficiency of educational services while empowering the school community through the development of internal business units (BUMS). This approach fosters institutional self-sufficiency, improves staff welfare, and sustains economic circulation within the school ecosystem. Programs such as waste alms, food waste repurposing, and project-based learning using recycled materials exemplify how educational practices can integrate regenerative principles of the circular economy.

The findings directly address the study's objectives and underscore the potential of schools to act as agents of social and environmental transformation through the implementation of closed-loop systems powered by digital innovation. The original contribution of this research lies in its development of a micro-scale, digital-based circular economy model within primary education—a novel approach rarely explored in existing literature.

Nonetheless, this study has several limitations: (1) its single-case design limits generalizability to other contexts; (2) technical issues such as unstable internet connectivity remain a challenge; and (3) the absence of long-term quantitative assessment means environmental and behavioral impacts remain partly anecdotal.

Future research is therefore recommended to:

a. Conduct quantitative assessments of environmental impact (e.g., reduction in plastic waste, emissions, paper use);
b. Compare schools with and without similar systems to assess contextual effectiveness;
c. Explore long-term behavioral change among students and families;
d. Evaluate the adaptability of IFDS-e M in schools with limited digital infrastructure.

In conclusion, the IFDS-e M model at SD Aisyiyah Gemolong represents a pioneering approach that integrates digital innovation with sustainability values in primary education. This initiative reaffirms the strategic role of schools in cultivating a circular lifestyle through technology, fostering behavioral transformation, and driving community-based innovation for a more sustainable future.

Declarations

Author contribution statement

Murdiyanto initiated the idea and all activities in this research paper. Yus Mochamad Cholily and Mohammad Syaifuddin as the parties who have been guiding the completion of the research paper.

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Data availability statement

The datasets generated during and analyzed during the current study are available from the corresponding author upon reasonable request.

Declaration of Interest's statement

The authors declare that they have no known competing financial interests or personal relationships that could have influenced the work reported in this paper.

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