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Analysing selective waste collection habits using the World Café Method: A case study among the students at the University of Pannonia

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In this study, one of the aims of applying the World Café Method (WCM) is to identify the barriers to selective waste collection among students at the University of Pannonia. According to the results, the most common barriers that influence selective waste collection behaviour are the lack of willingness, lack of infrastructure, and lack of credible information on separate waste collection. The second goal is to collect, together with the participants, suggestions for solutions to the problems identified, at three different levels.
The results of this study could contribute to strengthening a circular economy model that takes into account the interests of society and the economy, including the transformation of habits related to selective waste collection. It will also serve as input for further research and the development of educational content for impacting waste collection habits.

Keywords: selective waste collection; World Café Method; university students; habits

1. Introduction

Waste management has evolved significantly over the last decade as part of the circular economy, due to changes in its global trend (Durrani 2019, Karimi et al. 2023, Chintipalli et al. 2023). In Hungary, a new waste management system came into force on July 1, 2023, with a single concessionaire for the collection, treatment, and invoicing of municipal waste at the national level, replacing the current system of shared municipal and state waste management responsibilities with a centralized waste management system. The new system is aligned with EU recycling quotas: by 2040, 65% of total domestic waste should be recycled (Agovino et al. 2024). We aim to contribute to these targets through the work of our research team.

In the history of selective waste collection in Hungary, there has never been a uniform, national level of educational campaign, so in the current situation it may be of paramount importance to carefully establish its effectiveness. It is also significant that there is an opportunity and a need to develop coherent attitude-building programs linked to uniform collection.

Within the project Nr. 2022-1.1.1-KK-2022-00002, titled "Establishment of a competence center for waste management at the University of Pannonia", our task is to create educational content for the inhabitants related to selective waste collection, which will also lead to behavioral change. In other words, our sub-project aims to strengthen the commitment to separate waste collection. However, to develop appropriate educational content, it is necessary to understand the knowledge, behavior and habits of the population in relation to selective waste collection in Hungary.

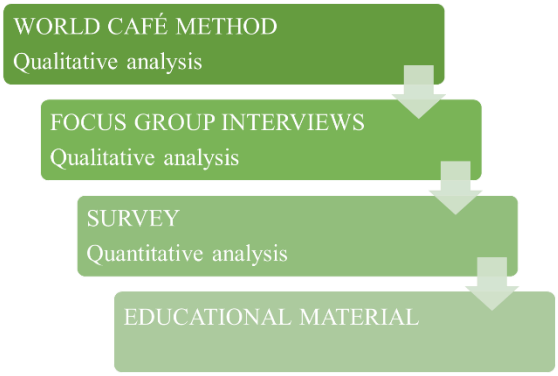
Therefore, as a first step, the goal of our subproject is to identify and understand the factors that keep the Hungarian population from collecting selective

waste. In this study, the World Café Method (WCM) was used. The WCM is an appreciated, inspiring and flexible participatory process, often used in combination with one or more other methods to identify emerging issues, gather best practices or suggestions, generate improvements or recommendations, and prioritize the implementation of projects or research agendas (Recchia et al. 2022).

In the application of the WCM, the obligations and opportunities for the public in relation to each waste stream are not yet known, especially with regard to individual, citizen responsibilities and legal requirements. No single education campaign is known for this period.

It should be stressed that the WCM and its results will be used as input for future research steps, such as focus group interviews and a questionnaire. The former method will provide deeper insights into the barriers to separate waste collection (Malhotra, 2009), while the questionnaire will allow us to understand the behavior of the population in relation to separate waste collection based on a large sample size. The interrelated studies are illustrated in Figure 1.

Figure 1. The research structure within the project



Source: own construction

One of the main advantages of this methodological triangulation (i.e. using several methodologies to analyze the same research question) is that we can check whether the results obtained with the different methods are correlated (Géring et al. 2014). The results of the WCM, the focus group interviews, and the questionnaire will help to scientifically substantiate the educational content related to selective waste collection and can effectively contribute to raising the awareness of the population and thus to increasing the amount of waste collected separately. This study presents the WCM related to selective waste collection and summarizes the results of our World Café rounds that have taken place up to the date of publication. The WCM for selective waste collection that we have developed has a dual purpose. The first objective (which is presented in the first part of our WCM) is to collect and group together the factors that hinder the selective collection of waste by the population. The second objective (which is in the second part of our WCM) is to gather together suggestions for solutions to overcome the barriers identified in the first part. In this phase of the research, the focus will not only be on good solutions that work, but also

on identifying and sharing innovative ideas. This paper starts with a literature review of the chosen method and continues with a description of the methodology and presentation of the results of our World Café rounds for selective waste collection. Finally, the main conclusions are summarized.

2. Literature review

Since the introduction of WCM over a decade ago, more than 200 publications based on it have appeared in Scopus-listed journals. The researchers highlighted the effectiveness of this method. For example, positive results are reported by Ropes et al. (2022). They led a three-World Café study of 18 participants to analyze the social and cognitive aspects of their participation. Participants enthusiastically reported how well the method encouraged people to share knowledge. Others talked about organizing their own café or similar event based on the example. They agreed that the usual workshop format and other types of low-interaction events, such as a lecture, provide a less effective environment for knowledge exchange. The organizers of the WCM found that the method, when adapted to the context, is well suited to achieving the desired research objectives (Ropes et al. 2020). Additionally, WCM has been used effectively in analyzing barriers and opportunities (Bertotti et al. 2012, Cosby et al. 2019, Kavanagh et al. 2020).

Löhr et al. (2020) complement the two well-established methods of qualitative research, semi-structured interviews and focus group studies, with the WCM, to help explore and control themes. As a participatory method, it not only generates data for the researchers but also potentially benefits the participants by facilitating dialogue and mutual learning, thereby motivating their participation and response (Löhr et al. 2020).

The WCM is used in different scientific areas, for example in the field of library and information science. The methodological strength of the research used was demonstrated by the way it brought the 'voice' of participants to the center by bringing out their experiences and engaging them in collaborative work with librarians (Kitzie et al. 2020).

Molnár and Földvári-Uricska (1998) used the Police Café in their study, a structured method to organize an innovative discussion to explore the possibilities of increasing public safety in the Hungarian police. Del Mar Gómez-Sánchez et al. (2024) used the method to assess the self-reported perspectives of participants in an intervention to prevent childhood overweight and obesity. Tessaro et al. (2023) used World Café data from 15 startup customers and suppliers to identify seven factors that explain how startups attract suppliers, maintain relationships with them, and achieve preferred customer status.

In addition to the examples mentioned, WCM have been applied in many other areas, including education (e.g. McDermott et al. 2020, Estacio et al. 2016) or health (e.g. Recchia 2022, Albrecht et al. 2022, Teut 2013). However, we could not find any research linking waste management, or within it, selective waste collection, to the WCM. One of the closest topics to our research that has been addressed with the WCM was renewable energy. Ruppert-Winkel et al. (2014) conducted a WCM with a mixed group of local actors and practitioners to explore the challenges of

achieving renewable energy self-sufficiency. They concluded that the method used had several positive outcomes: on the one hand, it facilitated joint thinking and exchange of ideas between participants to solve region-specific problems, and on the other hand, it contributed to future joint work and the setting of guidelines (Ruppert-Winkel et al. 2014).

Another issue concerns food waste. Folsberg et al. (2023) analyzed whether the public can be involved in the development of innovations to eliminate food waste. To answer this question, they used the WCM and, as in the present study, they involved university students to better understand the attitudes and habits of the growing generation.

A further study reports that the WCM was used to identify the elements that hinder or facilitate the transition from a linear to a circular economy in the Romanian textile and clothing sector (Staicu–Pop 2018). Based on the studies cited as examples, the method can be widely applied as a stand-alone qualitative research method or complement traditional methods, depending on the areas under study.

Although WCM has not been used by researchers to map behavior related to selective waste collection, several studies have analyzed it with different methods in the national and international literature. Usually, the researcher used a questionnaire to examine the behavior or habits of the households or consumers regarding the separate waste collection (for instance, Cheng et al. 2024, Sarker et al. 2024, Cantillo et al. 2023). The articles related to this topic often analyze different types of waste, like food (like Hermanussen–Loy 2024, Kunszabó et al. 2022, Olah et al. 2022, Stancu et al. 2016) or e-waste (for instance, Sabbir et al. 2023, de Oliveira Neto et al. 2022, Shaharudin et al. 2020, Saphores et al. 2012), however in our study we focus on all waste categories of the selective waste collection.

In the Hungarian literature, for example Németh and Mészáros analyzed the waste collection of households in Zala county. Based on their results, the barriers to separate waste collection are infrastructure and lack of space, while the most common response in terms of incentives is to implement door-to-door collection (Németh–Mészáros 2022). They also analyzed the attitude of the population in Győr-Moson-Sopron County towards selective waste collection, the scope of waste collected and the further fate of waste, and in priority cases the possibilities for reuse and recycling (Németh–Mészáros 2021).

In the Hungarian literature, the researchers mainly focus, for example, on food waste. For instance, Kunszabó and his colleagues carried out a food waste survey in Hungarian households. Their results show that Hungarian households underestimate their food waste levels, however, they think that they are able to reduce their food waste (Kunszabó et al. 2023). Another study demonstrates that the composting barriers of Hungarian inhabitants are lack of space, fear of rodents, and lack of knowledge (Kunszabó et al. 2022).

3. The World Café Method (WCM) in selective waste collection

We have chosen the WCM as a community participatory data collection method, which is recommended for a large group of participants. In our experience, the large number of participants and the repeated data collection with different participants in

the same way, ensured not only the exploration of themes, but also their verification and confirmation, and helped to avoid facilitation as a research methodological problem (The World Café Community Foundation 2015).

Another important reason for choosing this method is the assumption that people already have the wisdom and creativity to face the most difficult challenges (Wen-Long–Shih-Ting 2015) and are able to identify the problems of residential selective waste collection that have been present in Hungary for decades and to propose solutions. Thus, it also collects the knowledge that exists among the population.

For our project, we plan to study several groups of different statuses (including high school students, university students, active workers in the labor market, and elderly people). In this paper, we present our pilot study among students at the University of Pannonia. In this paper, we introduce the WCM in general terms, then we describe our samples and data collection process. Finally, we represent the results of our World Café rounds: first, we summarize what kind of factors can block the participants in the selective waste collection; and second, we organize the micro level solution suggestions that can be used to promote and support selective waste collection.

3.1. The WCM in general

The WCM can be defined as an exploratory qualitative data collection method, where experts are gathered in a workshop to share their knowledge between several discussion tables, each focusing on a different aspect of the research. It is sometimes referred to as a 'conversation café', a viable modern form of accelerating data collection (Ramasubramanian–Yadlin-Segal 2016). The WCM can be seen as a specific form of focus group research, or more precisely as a 'circulating focus group' (Schiele et al. 2022).

The WCM, as a special type of focus group research, is a novel research method that has emerged in the last decade. In contrast to the classic focus group, the WCM has many variations, particularly in terms of its design which divides the bargaining questions into different tables, and then participants randomly rotate tables and discuss each sub-question in small groups one after the other. This allows for cross-pollination of ideas, leading to richer data collection (Schiele et al. 2022, Löhr et al. 2020, Estacio–Karic 2015, Fouché–Light 2011).

A further advantage of the WCM is that it can be not only informative as a method of participation, but also beneficial for the participants, as it facilitates dialogue and mutual learning, thus motivating their participation and responses (Silva–Guenther 2018). The method allows team members to apply logical thinking and focus on adopting new perspectives to maximize the impact of the discussion and ultimately share collective discoveries. The discussion is question-based, encouraging members to share their views and listen to others to explore the context and the problem from multiple perspectives (Dawkins et al. 2017). The participants often appreciated the dynamic and supportive environment that reduced anxiety while fostering knowledge-sharing (Pinto-Pinho et al. 2023).

In order to use the WCM, its seven principles for planning need to be considered, which are the following: creating a context, creating a welcoming space, formulating important questions to be explored, encouraging everyone's input, connecting the diverse perspectives of participants, listening collectively to ideas and insights, and sharing ideas (The World Café Community Foundation 2015). Diversity and homogeneity should also be taken into account when putting together a team. Up to four to six people can sit at a table so that all participants can actively participate in the discussions (Schiele et al. 2022). In the process of the WCM, the groups usually last 30-40 minutes, with participants being given a different problem for each round. Participants meet each problem set, ensuring full transparency of ideas. The method harnesses the energy of small group discussions and develops shared learning on an interesting topic. The opportunity for interactions between participants gives everyone room to express themselves, revealing information that is still unstructured and unresolved. It allows access to collective wisdom in a natural setting, involving a larger number of participants, prioritizing and selecting information, avoiding researcher bias (Schiele et al. 2022). The collaborative work concludes with a large team discussion – in which all participants take part – reflecting the collective knowledge of the whole group (Wiley et al. 2018).

To assist in the use of the available qualitative data analysis method, the literature recommends the use of moderator(s) to plan and lead the event. They encourage careful discussion and elaboration of key issues in a series of parallel discussions. Moderators clarify the purpose and broad parameters of the exercise and share the issues the group wishes to discuss. All participants are encouraged to contribute to the discussion, listen to the samples, share their insights and questions. The moderator is also the timekeeper who ensures that participants move between tables at the agreed time. After the table discussions are completed, the moderator leads a larger group discussion to collect summaries and often to identify areas for future action (Schiele et al. 2022).

In sum, the WCM as a research method of scientific inquiry is a combination of rigor, relevance, and speed (Schiele et al. 2022). It is typically seen as an informal, relaxed process through which groups of people have the opportunity to engage in productive and structured discussion (Brown–Isaacs 2005). This method exhibited a significantly higher positive effect compared with traditional strategy workshops (Chang–Chen 2015). Previous adopters and participants of the method have appreciated its knowledge-sharing nature, and the learning experience provided by innovative thinking (Schiele et al. 2022).

3.2. Participants: The university students included in the study

For the study at the University of Pannonia, we looked at the university's student population as a group that could be easily organized. We narrowed down the WCM to three diverse groups of students, in which an important criterion was the targeting of students from different courses. The sample of the present research is limited, but we plan to continue the data collection using the WCM after the completion of this study by including additional groups such as other university students, secondary school students, employed people, or retired people.

When selecting the study sample, we aimed to have a mixed composition of the selected groups, so we held the World Café sessions in three different types of groups on three occasions. The characteristics of the students in each group are given in Table 1.

One difference between the groups was the age gap. In the second World Café group, part-time students of the Faculty of Humanities, who are working while studying at university and thus have independent incomes and run their own households were interviewed. Some of the group members may be responsible not only for themselves but also for their families (children and/or parents). The age distribution of that group varies, but they are mainly of an older generation compared to the other two groups. Another difference is that the first World Café is a mixed group, as we invited full-time students from the Faculty of Business and Economics, Faculty of Humanities, and Faculty of Information Technology.

Table 1. The 3 groups of the WCM related to the selective waste collection

	W1	**W2**	**W3**
Date	October 17, 2023	November 11, 2023	December 13, 2023
Enrolment type	Full-time students	Part-time students	Full-time students
Faculties	Faculty of Business and Economics, Faculty of Humanities, Faculty of Information Technology	Faculty of Humanities	Faculty of Humanities
Number of students	26	30	17

Source: own construction

The method was applied in the months of October through December 2023, within the normal timetable of the university courses, in normal classroom conditions. This allowed us to avoid the need to examine motivational questions (under- and over-motivation, compliance, and optimized responses) and additional screening criteria, such as reporting by interest, which would have significantly biased the responses. Participation was voluntary, and students were given a briefing on the methodology, the short and long-term aims of the research, and the relevant GDPR regulatory issues before using the WCM. Students participated anonymously in the study.

A WCM guide has been prepared to apply a common methodology, which will ensure comparable results in future research. In the guide, we recorded the questions and instructions to be asked. Particular attention was paid to the role of the moderator, with internal training to identify and filter out facilitating questions and suggestive moderator communication due to inadequate responses. We considered these to be research methodological problems to be avoided, often mentioned in the literature on WCM (Schiele et al. 2022).

3.3. Data collection process

Data collection was carried out in 3 steps using the WCM. Each step involved a different working technique. The steps of the data collection process and the working methods used are presented in Table 2.

Table 2. Data collection process

Data collection steps		Form of work
1	Collecting barriers to separate waste collection	Individual work
2	Grouping and categorizing the barriers to separate waste collection and naming the resulting groups	Large group work (involving all students together)
3	Substantive processing of the jointly developed categories and collection of proposals to remove or reduce the barriers to separate waste collection	Small groups of 4-7 people

Source: own construction

The first step in the WCM scenario was to find out what the factors are that hinder students from selective waste collection. Research experience in other disciplines has shown that when respondents are asked to make negative statements about themselves, they bias or distort the results (Kuncel et al. 2005).

To avoid this bias, the research question was formulated in an extended way, allowing respondents to report not only on their own personal experiences, or to formulate their own personal experiences in a way that was independent of themselves. In order to achieve this goal, we asked respondents the following question: *"What are the factors that prevent you, your friends, people you know or people you do not know from collecting your selective waste separately from household waste or from placing it in a designated waste bin?"* Students gave the barriers to separate waste collection that they identified, one by one, on a separate post-it note (one barrier written on one post-it note).

In the second step, we collected post-its from the students. We asked the students to show, one by one, what they had written on the post-its and to explain what exactly the word or concept on the post-it meant. The word presented was then pasted on a board on the wall of the classroom. We tried to group words with similar meanings close to each other. Once all the post-its were on the board, the words that were close to each other were reviewed again, and checked, with the help of the participants, to see if they really belonged to the same group. Students were then asked to give the groups a category name. These groups were considered as the main categories of barriers to separate waste collection. The number of categories thus formed by consensus of the participants was not predetermined.

In a third step, the students worked with the resulting categories in small groups. After rearranging the study site and creating as many workstations as the number of separate waste collection categories identified, students were distributed proportionally between the workstations (with an attempt being made to have the same number of students per workstation).

The workstations were set up in a circle around the room. On each desk, we placed a flip chart sheet with the name of the category of barriers to separate waste

collection written on the top. Students worked with one category at a time per group. They had a short time (7 minutes) to complete the task. When that time was up, the flip chart sheets were left on the worktable, while the group members moved to the next table and continued the work started by the other group. The changeover between tables was done in a rotating stage style, group by group. Groups of students moved to the next table until they returned to their starting position (the workstation where they first worked) so that they could meet the groups working on each category.

The students' task at each station was to find the solution. They were asked to come up with ideas and suggestions to eliminate barriers to separate waste collection or to reduce the impact of these barriers at three different levels. The three suggestion levels were as follows:

- micro (individual, family)
- meso (narrow community, for example: institutions, employers, educational institutions, local government)
- macro (state or legislative level)

We concluded the data collection by allowing each team to review the content of the category they had first developed and the comments they had written on the sheet. After a short preparation period, each team representative summarized and presented the main suggestions to the whole community.

3.4. Categorization of the data collected

The results of the data collected with the help of the students as described in section 3.2 are presented below. After grouping the post-its, the categories in Table 3 were created by the participants.

Table 3. Original names of categories

Category	**W1**	**W2**	**W3**
Ignorance	x	x	x
Laziness	x	x	x
Motivation, lack of motivation, disinterest	x	-	x
Economic	x	x	-
Infrastructure	x	-	x
Doubts	x	-	-
Habit	-	x	-
Lack of space	-	x	-
Indifference	-	x	-
Lack of time	-	-	x
Attitude	-	-	x

Source: own construction

Note: 'x' indicates that the category appeared in the World Café round, while '-' indicates that the category was not involved in the World Café round. 'W1', 'W2', and 'W3' indicates the round of the WCM.

In the analysis, we reviewed each category again. We were looking to see if there were any categories that only had a different name depending on which WCM occasion they were defined in but had similar content. Based on the similarities, the categories were grouped. Taking into account the content, we aligned the groups named Doubts and Habit with Attitude, the group Lack of Space with Infrastructure, and Indifference with Lack of Motivation. After merging, the following categories emerged (see Table 4).

Table 4. Concatenated categories

Category	**W1**	**W2**	**W3**
Ignorance	x	x	x
Laziness	x	x	x
Motivation, lack of motivation, disinterest indifference	x	x	x
Economic	x	x	-
Infrastructure, lack of space	x	x	x
Lack of time	-	-	x
Attitude, doubts, habituation	x	x	x

Source: own construction

Note: 'x' indicates that the category appeared in the World Café round, while '-' indicates that the category was not involved in the World Café round. 'W1', 'W2', and 'W3' indicates the round of the WCM.

We continued by rethinking the naming of the categories. Since the groups were named by the students (lay people) who participated in the study, the analysis involved revisiting the content of the groups in each category and trying to give the group a proper name based on the words written on the post-its for that group. This resulted in the categories in Table 5.

Table 5. New category names

Old name of category	**New category name**
Ignorance	Lack of knowledge
Laziness	Laziness
Motivation, lack of motivation/ disinterest, indifference	Lack of motivation
Economic	Economic aspects
Infrastructure, lack of space	Lack of infrastructure
Attitude, doubts, habituation	False beliefs, habits
Lack of time	Lack of time

Source: own construction

3.5. Analysis of barriers to separate waste collection

The categorization was followed by the preparation of the content analysis. The words and phrases (keywords) written on the post-its were collected in a common excel sheet. In total, a list of 113 items was obtained.

In the keyword cleaning process, similar words were given the same name, e.g. *lack of information* and *lack of knowledge* were replaced by *lack of knowledge*. Keywords with multiple words were replaced by a single word (e.g. *lazy* instead of *lazy people*), synonyms were also merged (e.g. *habit* instead of *habitual*), and where it was not possible to clean up using the original words, new keywords were generated (e.g. *lack of time* instead or *lack of time* and *takes time away from other things*; *false belief* instead of *throwing away a piece of rubbish does not change the environment*; and *lack of infrastructure* instead of *few public waste bins*).

The results after cleaning the 113 original keywords are summarized in Table 6. The list of original keywords is given in Appendix 1. *Laziness*, *lack of infrastructure* and *lack of knowledge* have a significantly higher share than the other barriers.

Among the factors collected, there was a high predominance of *laziness*. The results of previous studies also show that the groups studied have a relatively high level of environmental awareness at a theoretical level, yet many do little in practice to help their environment (Greenfo 2009). Although people know what they should do, something prevents them from translating knowledge into action. A further research direction could be to explore what factors influence the decision to act and the translation of knowledge into action.

There are examples in the literature of a link between littering and laziness (Schenck et al. 2022, Muñoz-Cadena et al. 2012). We could not find any studies linking separate waste collection and laziness.

Table 6. Occurrence and proportion of keywords

Words	**Number of occurrences**	**Share (%)**
Laziness	21	18.58
Lack of infrastructure	20	17.70
Lack of knowledge	17	15.04
Lack of space	9	7.96
Indifference	7	6.19
False belief	6	5.31
Lack of time	5	4.42
Lack of commitment	4	3.54
Attitude	3	2.65
Comfort	3	2.65
Habit	3	2.65
Disaffection	2	1.77
Tiring	2	1.77
Inattention	2	1.77
Lack of financial benefits	2	1.77
You have to pay for it	2	1.77
Lack of motivation	2	1.77
Lack of resources	1	0.88
Insatiability	1	0.88
Absence of sanction	1	0.88
Total number of words	**113**	**100**

Source: own construction

The second most common barrier is the *lack of infrastructure*, such as the lack of separate waste collection points. It can, therefore, be concluded that the willingness to collect separate waste and the lack of infrastructure have a negative impact on the willingness to take active measures. This is in line with Domina and Koch (2002) and Halvorsen (2012), who show that convenience is an important aspect of separate waste collection (Domina–Koch 2002), that the availability of infrastructure and measures to increase accessibility can have a positive effect on the intention to collect waste, but that the lack of infrastructure can have a negative effect (Halvorsen 2012). The factor of infrastructure deficiencies is also mentioned in other papers (see e.g. Hansmann et al. 2017, Ahmad et al. 2016).

Based on the results of a study conducted in Hungary, it can be said that, in addition to the two factors mentioned above, the problem we have also identified, i.e. the lack of credible information, and misconceptions among the population, are also prominent (Szűcs–Hámori 2016). Szűcs and Hámori (2016) also found that misconceptions about waste collection (e.g. separated waste is poured into one container during transportation) influence waste collection behavior.

Lack of knowledge also occurs with a high frequency, as shown in Table 6. This means that it is not clear to residents which waste can be deposited in which collection containers. Their situation is also complicated by the fact that the list of types of waste that can be deposited in separate waste collection containers may vary from one municipality to another. Our results are in line with the conclusions of previous research, as knowledge has been repeatedly identified in the waste management literature as an important direct or indirect influencing factor (Rozana et al. 2023, Cudjoe et al. 2022, Wu et al. 2022). Interestingly, the literature often examines the role of knowledge not only for selective waste collection, but also for the environment (see e.g. He et al 2022), but this concept has not been addressed in the World Café roundtables.

In Table 6, the lines highlighted with the same color can be grouped into common categories. Lack of space (e.g. no space for more bins in an apartment) and lack of infrastructure (e.g. few public bins) are both about the *lack of material conditions for separate waste collection.* Lack of knowledge (e.g. not sure which bin to put the waste in) and false beliefs (e.g. throwing away one bin does not change the environment) are common sources of *lack of credible information on separate waste collection*. The third major group comprises psychological phenomena related to the individual (e.g. lack of motivation, lack of commitment, attitude, convenience, habituation, and disinterest). These phenomena are collectively referred to as the *lack of willingness to separate waste collection.* Two smaller groups remain, the first of which is called *lack of financial benefits*, the others *lack of time.*

Table 7. Main categories of the barriers

Primary mergers	**Number of mentions**	**Percentage of mentions (%)**
Lack of willingness to separate waste collection	45	39.82
Lack of material conditions for separate waste collection	29	25.66
Lack of credible information on separate waste collection	23	20.35
Lack of financial benefits	5	4.42
Lack of individual skills	5	4.42
Lack of time	5	4.42
Lack of sanctions	1	0.88
Total	**113**	**100**

Source: own construction
Note: The colors of the rows show the categories and the items related to Table 6.

According to the results summarized in Table 7, the greatest barrier to separate waste collection among the respondents of the present study (almost 40% of the barriers collected by the WCM) is the *lack of willingness to separate waste collection.* The other two significant factors influencing separate waste collection habits are the *lack of material conditions for separate waste collection* (25.66% of responses) and the *lack of credible information on separate waste collection* (20.35%). Other influencing factors are the lack of financial benefits (4.42%), lack of individual skills (4.42%), lack of time (4.42%), and lack of sanctions (0.88%). Interestingly, the lack of financial benefits has a relatively low prevalence, which suggests that further research may be worthwhile to investigate the extent to which financial rewards may be a strong motivating factor for selective waste collection in Hungary.

From a project perspective, the results of the World Cafés show that there is a need for educational content that provides credible and accessible information. At the same time, the development of educational content should also aim to take into account not only the sharing of knowledge but also the promotion of the willingness to collect waste selectively.

3.6. Micro-level solutions for each problem area

In the second part of our WCM, participants collected possible solutions within the categories they had developed, at three levels:

- micro level: what can individuals and their close environment (e.g. family members, friends, colleagues) do to remove or mitigate barriers to separate waste collection?
- meso level: how can local government and organizations tackle barriers to separate waste collection?
- macro level: what can the state do to reduce or eliminate barriers to separate waste collection?

Since the aim of our project is to shape social attitudes and to develop educational content that will change the individual's actions and waste collection habits in a positive way, we first analyzed the solutions proposed at the level of individuals and families – in this paper, due to the space limitations, we present the results of this analysis only. A total of 129 micro-level solutions were proposed in the 3 rounds of the World Café. Interestingly, more ideas were received at the meso level (148 solutions) and at the macro level (145 solutions).

The first step of the analysis is to clean the data, deleting micro-level solutions that are not related to the topic (e.g. less car use), belong to the meso or macro level instead of the micro level (e.g. cash-dispensing vending machines), or it was not clear from the brief wording what exactly the idea owner had in mind (e.g. cleaning concept). After cleaning, 118 micro-level solution suggestions remained. Next, the synonyms were combined to form small groups of micro-level solution proposals. In total, 27 groups were obtained, which are shown in the first column of Table 8. The most frequently mentioned solution suggestion is gathering information and receiving orientation (20 occurrences). For example, this includes watching David Attenborough's documentaries, or short films and videos about the environment, or gathering information about which product should be placed in which selective collection bin. This group further reinforces our finding that there is a need for easily accessible, understandable, and credible educational content. In particular, information sharing in video format (David Attenborough films, documentaries, non-stimulative films, 5 occurrences in total) were frequently mentioned, alongside social media (1 occurrence) and ppt presentations (1 occurrence).

The second most common group is the creation of individual conditions for separate collection in their own environment (11 occurrences), which includes solutions such as the use of a composter, creativity in waste storage, or a bin with several levels (to store several types of waste in the same place). These solutions are also significant because the second biggest problem in separate waste collection is the lack of material conditions for separate waste collection. At the national level, the most effective solution could be provided by the waste management company (e.g. more collection islands, more frequent emptying), but as our results show, the lack of physical conditions also implies the responsibility of the individual.

In the proposed solutions, a process can be detected, which we have identified in 3 separate phases based on our database (column 4 in Table 8): social influence, interiorization, and overriding individual habits. Thus, we categorized the participants' ideas according to these 3 stages.

Social influence is the second largest category in our database. Within this category are ideas that aim to influence the behavior of others. This category may raise further research questions: is the reason why this group of solutions is so significant because of its role that participants attributed to the subjective norm, i.e. they believe that individuals are significantly influenced by mainstream trends, social customs, and expectations? This issue will be explored through a questionnaire as the next step of the project.

At this point, a parallel can be drawn between our results and Ajzen's 1991 model, since in his Theory of Planned Behavior, too, social influence (subjective norms) results in changes in individual behavior. Based on the results published so far,

questionnaire surveys conducted in Pakistan and China based on Ajzen's 1991 model suggest that subjective norms have an indirect effect on behavior related to selective waste collection through intention (Li et al. 2023, Dong et al. 2023, Wang et al. 2022).

At the same time, in interpreting the impact on others, it can also be found that the individual, rather than acting on their own, would first look to others for guidance and correct behavior. That is, procrastination may also appear here. This could also be an interesting line of research to see to what extent procrastination plays a significant role in influencing behavior related to selective waste collection and whether people recognize their own responsibility in this area. Examples of research on procrastination can be found in the area of food waste (see Da Costa et al. 2021, Porpino et al. 2016), but not in separate waste collection. In any case, this approach also highlights the role of subjective norms.

Table 8. Summary of individual solution suggestions

Micro level solutions	Absolute frequency	Relative frequency	Category name	Absolute frequency	Relative frequency
Individual information gathering, orientation	20	16.95%	Overriding individual habits	49	41.53%
Creating individual conditions for separate collection in your own environment	11	9.32%			
Active action	5	4.24%			
Exploring recycling opportunities	5	4.24%			
Conscious shopping	3	2.54%			
Setting individual goals	2	1.69%			
Sole proprietorship for waste collection	1	0.85%			
Lifestyle change	1	0.85%			
Striving for self-sufficiency	1	0.85%			
Education in the family, shaping attitudes	8	6.78%	Social influence	37	31.36%
Rewards, positive reinforcement	6	5.08%			
Follow a role model or influencer	6	5.08%			
Setting an example	4	3.39%			
Penalty, negative reinforcement	3	2.54%			
Sharing the results with others	3	2.54%			
Awakening motivation in others	3	2.54%			
Attention	2	1.69%			
Exchange information with others	1	0.85%			
Initiating a community movement	1	0.85%			
Taking individual responsibility	7	5.93%	Interiorization	32	27.12%
Shaping mindsets	5	4.24%			
Exercising self-discipline	4	3.39%			
Self-development	4	3.39%			
Awakening motivation within ourselves	4	3.39%			
Developing a positive attitude in ourselves	4	3.39%			
Awareness	3	2.54%			
Realization	1	0.85%			
Total	**118**	**100%**		**118**	**100%**

Source: own construction

The next category is *interiorization*, also known as the internalization of personal factors, related to selective waste collection. Interestingly, this category was found to have the lowest relative frequency. Since the main problem with the factors that hinder separate waste collection is the lack of willingness to collect waste, it would have been expected that the factors related to willingness and personality would also appear more frequently among the suggestions for solutions. However, it may also show that further findings are needed to have a detailed understanding of the process of internalization. A starting point for this could be Ajzen's 1991 model, so the next step of our project could be to use this methodology in the questionnaire survey.

The category with the highest relative frequency is *overriding individual habit*, which covers the actions that it would be appropriate for an individual to take in order to separate waste. Factors such as collecting information, creating individual conditions for separate waste collection, taking active action, seeking recycling opportunities, or conscious purchasing are all factors that are considered here. The suggestions for solutions in this category also suggest that interiorization may be necessary, otherwise there will be no change in the individual's previous habits.

4. Summary

In this study, we have presented the results of 3 different studies in a group of 73 university students. The aim of the study has been to identify the barriers to separate waste collection and to collect suggestions for solutions to the problem in order to formulate measures to address these barriers in the future. The novelty of the study is that it was carried out using the WCM.

Among the respondents to this survey, the main barriers to separate waste collection have been shown to be the lack of willingness to separate waste collection, the lack of material conditions for separate waste collection, and the lack of credible information on separate waste collection. The latter barrier has confirmed for our project the need for credible, accessible educational content. However, our results have also shown that it is not enough to provide information, but that the willingness of individuals and its determinants should also be taken into account when developing educational content.

In the current study, we have collected and analyzed micro-level solutions for changing waste collection habits, i.e. for the individual and his/her close environment. The most common solutions are related to individual information gathering, awareness raising, and the creation of individual conditions for selective collection in people's own environment. In the former, knowledge sharing in video format has been mainly highlighted by the participants. At the same time, the need for authentic, accessible educational content has been further confirmed for the sub-project. The high frequency of the category 'Creating individual conditions for separate collection in your own environment' is also a significant result, as it shows that solutions to the lack of material conditions for selective waste collection as a barrier to the selective waste collection can be found not only at the meso and macro levels but also at the micro level. This result also underlines the importance of individual responsibility.

In the process of categorizing the proposed solutions, three stages of a process have been identified: social influence, interiorization and overriding individual habits. These factors are in line with the conclusions drawn by Ajzen (1991), which suggests that future research could be directed towards the study of behavior related to selective waste collection using his theory of planned behavior. The results of this study suggest that social influences and norms may play a key role in the behavior associated with selective waste collection.

Based on our results, we see two areas of intervention for our project. The first is information dissemination, i.e. the transfer of material knowledge on selective waste collection to residents. In sharing information, attention should also be paid to ensuring that this knowledge is retained. The other area of intervention is behavioral modification, i.e. actions aimed at deliberately and purposefully changing individual behavior.

5. Future directions and limitations

This study is the first in a series of investigations. To ensure the generalizability of the data, it is necessary to increase the number of elements in the study sample and to select and include representatives of other socio-demographic groups. Therefore, as a further step in our research, we plan to conduct a WCM among high school students, retired people, employed people, and students from other faculties. A further line of action is to summarize and organize the proposals for solutions at the micro, meso, and macro levels, and to use them as a basis for proposing measures to decision-makers.

In addition to the wider use of the WCM, we will refine our findings in the future through focus group interviews and questionnaire research. Focus group research will allow us to explore and understand the deeper context of the phenomenon. The questionnaire survey will allow us to draw conclusions about the behavior of the population in relation to selective waste collection and its determinants based on Ajzen's 1991 model, using a larger sample size. The results of the three methods can contribute to the scientific basis of educational content.

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Appendix:

Appendix 1. Barriers to separate waste collection

Keywords on Post-it	**Cleaned keywords**
Bring the problem to the families, up to the level of physical availability	Lack of infrastructure
there are no facilities in the municipality	Lack of infrastructure
Will	Attitude
Not paying attention to your surroundings can also be an obstacle	Inattention
People are lazy	Laziness
The lack of time	Lack of time
Habit established	Habit
Candy wrappers where can they go? Toilet paper rolls go with the paper? And the spiral notebook?	Lack of knowledge
Just a conspiracy theory: it is not even recycled	False belief
Throwing away a piece of rubbish does not change the environment	False belief
I can't do anything with it alone anyway	False belief
Disinterestedness	Lack of commitment
Disinterestedness	Lack of commitment
Disinterestedness	Lack of commitment
Not available in village	Lack of infrastructure
Tiring for some people	Tiring
Inattention	Inattention
Physically, there is no well-designed system. Only for PET.	Lack of infrastructure
Negligence	Attitude
Lack of space	Lack of space
Lack of space	Lack of space
Lack of space	Lack of space
Lack of space	Lack of space
Lack of time	Lack of time
Lack of time	Lack of time
Takes time away from others	Lack of time
Insatiability	Insatiability
Lack of information	Lack of knowledge
Lack of knowledge (what can be collected separately and in which bin)	Lack of knowledge

Lack of knowledge. People do not know exactly how separate collection works	Lack of knowledge
Lack of knowledge	Lack of knowledge
Discourtesy	Indifference
Comfort	Comfort
few public waste bins	Lack of infrastructure
Few options	Lack of infrastructure
Few options for separate waste storage	Lack of space
Few recycling bins in public places	Lack of infrastructure
Indifference	Indifference
Indifference	Indifference
Indifference (not my problem/job)	Indifference
Far from home is only possible	Lack of infrastructure
Legends about waste management	False belief
I am lazy	Laziness
Lazy waste sorting	Laziness
Laziness	Laziness
Laziness	Laziness
Laziness	Laziness
Laziness	Laziness
Laziness	Laziness
Laziness	Laziness
Laziness	Laziness
Laziness	Laziness
Laziness	Laziness
Laziness	Laziness
Laziness	Laziness
Laziness	Laziness
Laziness	Laziness
Laziness	Laziness
Laziness	Laziness
Laziness	Laziness
Laziness	Laziness
Laziness	Laziness
Habit	Habit
Many selective islands have been eliminated	Lack of infrastructure
Because you have to pay to drop off your waste	You have to pay for it
Why collect when they do nothing in other major countries like Thailand	False belief
Lack of motivation	Lack of motivation
Lack of motivation	Lack of motivation
Not my problem	Lack of commitment
Not sure which one to throw in	Lack of knowledge
Lack of an appropriate collection method	Lack of infrastructure
Lack of an appropriate collection method	Lack of infrastructure
Non-established habits (elderly)	Habit
They don't care about the environment, so they don't collect separately	Indifference
I don't care attitude	Indifference
Carelessness	Indifference
Not nearby	Lack of infrastructure
Not enough money is invested in the processing of selective waste	Lack of resources
Not enough space at home	Lack of space
I don't have space for collecting multiple types of waste	Lack of space

No direct consequence or penalty	Absence of sanction
Not enough recycling bins	Lack of infrastructure
There are no large or small collection points in the city	Lack of infrastructure
Self-centeredness	Disaffection
Selfishness	Disaffection
Not enough space for more bins in a panel	Lack of space
Panel apartment	Lack of space
Automatic cash dispenser	Lack of financial benefits
Automatic cash dispenser	Lack of financial benefits
Bad experience	False belief
Haste	Lack of time
It is much easier to collect non-selectively (less time, energy, etc.)	Comfort
Delivery high fee	You have to pay for it
Lack of selective collectors (e.g. I don't remember seeing any in Pátka)	Lack of infrastructure
Lack of separate waste collection	Lack of infrastructure
Lack of separate waste collectors	Lack of infrastructure
Personal attitude	Attitude
Need to be sorted	Tiring
Ignorance	Lack of knowledge
Ignorance	Lack of knowledge
Ignorance	Lack of knowledge
Distance	Lack of infrastructure
No possibility in settlements	Lack of infrastructure
Ignorance	Lack of knowledge
Ignorance	Lack of knowledge
Ignorance	Lack of knowledge
Ignorance	Lack of knowledge
Ignorance	Lack of knowledge
Ignorance	Lack of knowledge
Ignorance	Lack of knowledge
Too far to the separate waste bin	Lack of infrastructure
Too much work	Comfort
Someone still doesn't know how to collect separately	Lack of knowledge

Source: own construction