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Estimation of the relationship between revenue and working hours of a recyclable waste picker: Perceptions from the participant's point of view

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Abstract: The text is an excerpt from a doctoral thesis that studies a recyclable waste picker from the perspective of linear regression and helps us understand the financial impact of recyclable waste pickers' use of that strategy in the São Paulo countryside and how this promotes awareness. The research aims to estimate the relationship between a participating picker's revenue and her working hours. The study was carried out in three stages: theoretical basis, intervention and discussion, and data analysis. The proposed mathematical model aims to estimate the relationship between the picker's revenue and working hours, with the proposal of incentives for decisions that meet the expectations of these professionals. The research seeks to contribute to searching for and disseminating solutions to foster inclusion and improve pickers' quality of life, promoting significant societal transformations.

Keywords: Inclusive Mathematics Education. Recyclable Materials Picker. Social Vulnerability.

Evaluación de la correlación entre los ingresos y las horas de trabajo de una recolectora de materiales reciclables: Percepciones desde el punto de vista de la participante

Resumen: El texto es un extracto de una tesis doctoral que estudia a una recolectora de material reciclable desde la perspectiva de la regresión lineal y nos ayuda a comprender el impacto financiero que puede causar su uso por parte de los recolectores de material reciclable en el interior de São Paulo y cómo esto promueve la concienciación. La investigación tiene como objetivo estimar la relación entre los ingresos de una recolectora participante y su jornada laboral. El estudio se realizó en tres etapas: base teórica, intervención y discusión, y análisis de datos. El modelo matemático propuesto tiene como objetivo estimar la relación entre los ingresos de la recolectora y su jornada laboral, con la propuesta de incentivos para decisiones que atiendan las expectativas de estos profesionales. La investigación busca contribuir a la búsqueda y difusión de soluciones para fomentar la inclusión y mejorar la calidad de vida de los recolectores, promoviendo transformaciones sociales significativas.

Palabras clave: Educación Matemática Inclusiva. Catadoras de Materiales Reciclables. Vulnerabilidad Social.

Estimativa da relação entre receita e horas de trabalho de uma catadora de materiais recicláveis: Percepções a partir do ponto de vista da participante

Resumo: O texto é um recorte de uma tese de doutorado que estuda uma catadora de materiais

recicláveis sob a ótica da regressão linear e nos ajuda a entender o impacto financeiro que sua utilização por catadores de materiais recicláveis do interior de São Paulo pode causar e como isso promove conscientização. A pesquisa tem como objetivo estimar a relação entre a renda de uma catadora participante e sua jornada de trabalho. O estudo foi realizado em três etapas: fundamentação teórica, intervenção e discussão e análise de dados. O modelo matemático proposto tem como objetivo estimar a relação entre a renda da catadora e a jornada laboral, com a proposição de incentivos para decisões que atendam às expectativas desses profissionais. A pesquisa busca contribuir para a busca e disseminação de soluções para fomentar a inclusão e melhorar a qualidade de vida dos catadores, promovendo transformações sociais significativas.

Palavras-chave: Educação Matemática Inclusiva. Catadores de Materiais Recicláveis. Vulnerabilidade Social.

1 Introdução

The recycling of materials has been identified as an important alternative for environmental sustainability and for generating income for many families, especially for recyclable waste pickers (Bouvier & Dias, 2021). These workers often face challenges related to the informal knowledge of mathematics, which is essential for managing their work (Dagnino & Johansen, 2017). Considering this perspective:

> The difference principle, in its simplest form, states that economic and social inequalities should be arranged so that they are simultaneously (a) to the greatest benefit of the least advantaged and (b) attached to offices and positions open to all under conditions of fair equality of opportunity (Marin & Quintana, 2012, p. 516).

With this challenging scenario in mind, the present research aims to estimate the relationship between income and working hours of a female recyclable material collector in a small town in the interior of São Paulo using linear regression. The research seeks to contribute to overcoming her daily challenges by proposing a mathematical model based on linear regression that allows for the estimation of the relationship between income and working hours of recyclable material collectors, encouraging efficient decision-making, and offering valuable insights into the economic dynamics faced by these workers. In this way, the study indirectly aims to promote awareness and social inclusion of collectors and contribute to building a just and sustainable society through education.

Adopting the linear regression approach, we aim to establish a solid analytical foundation to assess how the time invested in work can directly influence this worker's income. In doing so, we hope to provide a quantitative view and capture nuances and qualitative perceptions that contribute to a more holistic understanding of this relationship. The proposed analysis thus aims to provide a platform for broad discussions on public policies, incentive programs, and the recognition of the work of recyclable material collectors.

By exploring these estimates, we aim to highlight not only the economic issues involved but also the social and environmental implications, recognizing the fundamental role of these professionals in building a sustainable society. By presenting the insights derived from the linear regression analysis, this article demonstrates potential contributions to raising awareness, fostering dialogue about working conditions, and recognizing the work of recyclable wast collectors.

In this context of uncertainties in thought, communication, and education, Freire (1967, p. 41) emphasizes that:

> It cannot be perceived that only in communication does human life find meaning. The educator's thinking only gains authenticity in the authenticity of the students' thinking, both mediated by reality and, therefore, in intercommunication. Thus, the educator's thinking cannot be a thinking for the students nor imposed upon them. Hence, it should not be an isolated thinking, in an ivory tower, but rather in and through communication around, let us repeat, a reality.

In any case, when considering education, communication, and social inequality, the study proposes reflections on critical mathematics education, solidarity economy, and social justice in the context of recyclable material collectors. Thus, we seek to estimate the relationship between income and working hours of a recyclable material collector from a city in the interior of São Paulo through linear regression and, consequently, how these experiences can foster awareness and reflections.

2 Theoretical Support

In this section, we provide a brief theoretical foundation that underpins the research, elucidating the essential pillars of critical mathematics education. Critical mathematics education aims to promote a reflective and participatory approach to teaching mathematics. Additionally, we explore the concepts of solidarity economy, which focuses on more collaborative and sustainable economic practices and social justice, aiming for equity and inclusion within educational and economic contexts.

2.1 Critical Mathematics Education

Critical mathematics education represents a pedagogical approach that seeks not only the development of students' mathematical skills but also fosters critical reflection on the complex social relationships that permeate the field of mathematics (Skovsmose, 2007). The framework of critical mathematics education provides a significant theoretical foundation for a deep understanding of the relationship between income and working hours for a waste picker, integrating mathematical aspects with a social and critical perspective.

By embracing this theoretical foundation, we recognize the importance of moving beyond mere quantitative analysis and considering the sociocultural contexts in which waste pickers operate. Critical mathematics education advocates for a reflective approach that highlights economic and social inequalities, encouraging a critical examination of mathematical relationships –such as the linear regression equation in our study–within the broader context of a waste picker's working and living conditions. It is worth noting that this pedagogical approach has its roots in critical pedagogy, affirming the belief that mathematics can be a powerful tool for questioning reality and contributing to the construction of a just and equitable world.

Critical mathematics education aims to enhance citizens' ability to think critically and apply mathematics in real-world contexts. It seeks to stimulate constructive dialogues, reduce inequalities, foster inclusion, encourage participation, and promote social justice, with special attention to mitigating social vulnerability (Skovsmose, 2001).

By applying the principles of critical mathematics education, we do not merely seek to generate numbers and statistics; rather, we aim to raise awareness about the social implications of these mathematical relationships. This approach allows us to consider waste pickers not just as numerical entities in an equation but as individuals embedded in a complex social fabric. In doing so, we emphasize the need to promote a mathematical understanding that extends beyond the classroom and contributes to the emancipation and empowerment of these workers.

When addressing critical mathematics education, we understand that it goes beyond the mere development of mathematical competencies. It serves as a conduit for questioning how mathematics is taught and applied in society (Skovsmose, 2001). Therefore, it is essential to recognize the significance of this approach in fostering critical reflection on the intricate social relationships involved in the realm of mathematics.

In this way, critical mathematics education provides an interpretative lens that enriches the analysis of the relationship between revenue and working hours, encouraging us to consider the ethical and social implications of our research. This critical perspective not only broadens the scope of our inquiry but also aligns our study with a more inclusive and just view of mathematics, acknowledging its role in social transformation and the development of critical consciousness.

2.2 Solidarity Economy

Solidarity economy emerges as a robust theoretical foundation for analyzing the relationship between income and working hours of a waste picker, providing a context that extends beyond traditional economic structures. By incorporating the principles of cooperation, self-management, and solidarity, solidarity economy offers a perspective that directly aligns with the practices and challenges these workers face. At the heart of this approach lies the recognition of the importance of inclusive economic structures that promote equity and value labor –fundamental aspects for understanding income dynamics and working hours in the context of waste pickers.

Solidarity economy is characterized as a set of economic activities organized based on self-management, cooperation, and solidarity. This approach promotes the creation of new forms of production, distribution, and consumption of goods and services, aiming to transcend the traditional economic model centered around competition and profit-seeking. Instead, it prioritizes valuing human labor, environmental preservation, and promoting social equity and justice (Marin & Quintana, 2012).

Applying solidarity economy principles to our study, we seek to estimate the relationship between income and working hours of a recyclable waste collector from a city in the São Paulo countryside using linear regression. The emphasis on self-management suggests the need to empower waste pickers to actively participate in economic decisions that affect them, directly influencing the linear regression equation regarding how work time translates into income. The solidarity economy informs our analysis and points to potential solutions and approaches to improving working conditions and remuneration for waste pickers.

In this way, by grounding itself in principles such as participatory democracy, self-management, cooperation, sustainability, and solidarity, the solidarity economy represents an alternative for constructing a fair, sustainable, and inclusive proposal. Furthermore, by adopting the perspective of a solidarity economy, we enable the connection to a broader movement of economic transformation, emphasizing the importance of considering not only financial aspects but also social and environmental impacts. When exploring the relationship between income and working hours through the lens of a solidarity economy, we can contribute to building a more holistic and just understanding of waste pickers' activities, aligned with the ideals of a solidary and inclusive economy. In this context, we recognize that the connection between critical mathematics education and solidarity economy can be understood as a strategy to promote citizens' more critical and conscious education, empowering them to analyze and question existing economic structures and practices.

2.3 Social Justice

Social justice comprises a set of ethical and political principles aimed at promoting equality and equity in society, ensuring that all individuals have opportunities and resources that allow them to lead a dignified and fulfilling life. Like the solidarity economy, it involves actions that seek resource redistribution, combat socio-economic inequalities, and fight against social exclusion to construct a just and egalitarian society for all (Taveira & Peralta, 2022).

The perspective of social justice provides a decisive theoretical framework for analyzing the relationship between income and working hours of waste pickers, emphasizing the importance of economic approaches that strive for equity and inclusion. When considering the linear regression equation as a mathematical representation of this worker's financial dynamics, social justice prompts reflection on how economic disparities can be mitigated to ensure fair working conditions and more equitable distribution of the revenue generated by their activities.

The social justice approach proposes a critical analysis of structures that perpetuate inequalities, leading us to question not only the mathematical outcomes of our research but also the social and economic conditions that shape these results. Social justice implies adopting public policies that advocate for equality and equity across various areas of social life, such as education, health, housing, labor, and security (Souza, 2018).

In this context, an essential consideration within the realm of mathematics education for social justice lies in guaranteeing all citizens access to quality mathematics education, free from discrimination based on gender, ethnicity, religion, sexual orientation, or socioeconomic status (Souza, 2018). It also involves promoting equal opportunities and combating exclusion and social marginalization through mathematics education (Taveira & Peralta, 2022).

Within education, social justice means ensuring access to quality education for all individuals, regardless of their social and economic background. This necessitates inclusive and equitable educational policies, as mentioned by the cited authors, ensuring that each student has access to quality education that allows them to develop their full potential (Freire, 1967 & Skovsmose, 2001).

By embracing the theory of social justice, we engage in discussions about the relationship between income and working hours under the auspices of social justice. This underscores the importance of understanding social implications and guides practices and policies that promote a fairer and more equitable distribution of economic resources, aligning with the fundamental principles of social justice.

Thus, social justice is fundamental to building a more just and egalitarian society for all, guaranteeing access to quality services and resources and combating socioeconomic inequalities and social exclusion.

3 Classifying our Research

We used different classifications to describe the methodology adopted in this research. Regarding the approach, our research falls into the category of qualitative research, as this method is not concerned with numerical representativeness but rather with understanding a social group (Gerhardt & Silveira, 2009). Concerning the nature of the research, we classify it as applied, as its objective is the practical application of scientific knowledge to solve specific problems or develop new technologies (Gil, 2007). The nature of the research is intrinsically linked to the pursuit of tangible and valuable solutions for real-world issues. As for the objectives, the research is exploratory (Gerhardt & Silveira, 2009). Finally, in terms of procedures, our research is classified as bibliographic and ethnomethodological, based on a

field case study (Gil, 2007).

3.1 Path Traveled

Data collection was carried out through participant observation, documentary research, and semi-structured interviews. The research was divided into three stages: (1) Theoretical Foundation, (2) Intervention, and (3) Discussion and Data Analysis. The first stage was presented in Section 2 of this article.

The second stage, Intervention, was dedicated to conducting an interview with our participant and daily monitoring to collect the necessary information for constructing an individual mathematical model. In this stage, the study was divided into three phases:

In the first phase, we interviewed a waste picker from a city in the São Paulo countryside. The research involved obtaining informed consent through a Free and Informed Consent Form (FICF), which outlined the project and the entire path to be followed. The interview lasted approximately 90 minutes. The objective was to explore various aspects of her daily life, including her everyday challenges, experiences in the work environment, daily income, as well as her aspirations and difficulties related to waste picking.

The second phase involved daily monitoring of the waste picker over one month. The goal was to collect data necessary for constructing an individual mathematical model for the participant. These meetings took place throughout July 2022, totaling thirty consecutive days. They occurred near a commercial establishment specialized in purchasing recyclable materials. The approach fostered an environment of mutual respect, care, and solidarity, where the participant shared her experiences and challenges related to street work.

The participant collected different types of recycling materials, the time spent during work, and the daily income earned from her work. Additionally, the obstacles faced in generating an adequate income were highlighted, along with the discrimination and lack of respect experienced by the recyclable materials collector.

In this way, the research process with participant Sandra provided an understanding of the routine, challenges faced, and factors influencing the performance of recyclable materials collectors. Furthermore, the study aimed to align information on how critical mathematics education, solidarity economy, and social justice can assist in decision-making and improve working conditions for professionals in this field.

The final encounter, third phase, occurred at the end of this observation process to present a mathematical model to the participant, discuss its advantages and disadvantages, and share experiences from the participant's journey. Thus, we proposed a mathematical model as a decision-making tool for the recyclable materials collector.

In the third stage of the research, data discussion and analysis, we analyzed the initial interview, follow-up, and final encounter results, which allowed us to present a mathematical model based on linear regression that could serve as an instrument for the participant's decision-making.

3.2 Introducing Sandra

The participant in our research, Sandra, is a recyclable waste picker who resides in Campinas, in the São Paulo countryside, Brazil. She is 52, retired, married, and has one daughter. She has been doing waste picking for approximately five years, working from Monday to Friday and sometimes even on Saturdays. Her work involves collecting various

recyclable materials such as plastic, aluminum cans, and scrap. Sandra completed secondary school and holds a technical degree in nursing. As a retiree, she receives a remuneration equivalent to the minimum wage.

4 Results and discussion

Let us delve into the results and discussion based on the observations of Sandra's daily routine. We will consider the initial interview, the monitoring process, and the final meeting.

4.1 The Beginning

In her own words, Sandra describes the difficulties and instability in her profession and the constant challenge of facing social vulnerability. She also emphasizes her desire for improvement and the importance of social equity. During the initial interview, we identified that Sandra aims to work approximately five hours a day and earn R$ 75.00 daily.

Interestingly, despite not having specific formal training in the field, Sandra demonstrated an interest in understanding the application of critical mathematics education in her activities. We observed this during her accounts of material choices during collection and the weight she had to carry, where she implicitly considered addition and multiplication operations. Thus, analyzing critical mathematics education, as demonstrated by Skovsmose (2001), allowed us to recognize Sandra's critical thinking regarding mathematical operations in her work and reinforced the importance of mathematics education for waste pickers.

In this context, Skovsmose (2007, p. 176) eloquently states:

> I am interested in the possible role of mathematics education as a gatekeeper, responsible for admitting people and stratifying them. I am concerned about any discourse that might attempt to eliminate the sociopolitical aspects of mathematics education and define politically determined learning obstacles as personal failures. I am concerned about how racism, sexism, and elitism could operate within mathematics education. I am concerned about the relationship between mathematics education and democracy.

The concept of mathematics education acting as a "gatekeeper," determining who has access to specific social spaces and professional opportunities, is a topic of great relevance discussed by researchers and educators. Furthermore, it is crucial to recognize that barriers to learning mathematics often originate from political and cultural issues, such as financial and educational resource scarcity, racial and gender discrimination, and social exclusion (Skovsmose, 2007).

Returning our focus to the participant's work and her critical perspective amidst social vulnerability, we must emphasize that, as Da Costa Vieira (2020, p. 1848) mentions: "Collecting recyclable materials is an ancient process that gained value through environmental movements advocating for potential sustainability." In this context, the author adds that "[…] it still carries the stigma dating back to the Middle Ages when only certain individuals were designated to work in the final disposal of waste, based on their marginalized condition as prisoners, prostitutes, and slaves" (Da Costa Vieira, 2020, p. 1848).

Thus, we highlight the recyclable waste pickers' vulnerability and their need to be seen. These collectors are not always "seen" during their daily journey; nevertheless, some people notice them and even set aside items for donation, as Sandra mentions.

Facing these daily challenges in choosing objects, drawing from Paulo Freire's (1967)

perception, we must consider critical mathematics education as a form of freedom in the work of collectors—a liberating force intended for vulnerable populations. In this text, we demonstrate that liberating educational practices enhance the educational interest of urban populations, directly linked to the flexibility of their consciousness (Freire, 1967), maintaining the conviction that something to share may transform societal ideas.

We identified several relevant aspects during the initial interview with Sandra, which took place in the first phase of stage 1 of the research. Throughout the interview, she described various difficulties experienced in her daily work, such as choosing the path to be taken, carrying the weight of materials, and the treatment she receives from people on the streets, among others.

Considering her participation, Sandra confirms the importance of her contribution to the environment but laments that society still does not fully comprehend this significance. During the interview, she expressed a strong desire for improvements in her life but also conveyed a sense of powerlessness in the face of the challenges she must confront. The initial interview allowed the researcher to profile Sandra and identify her work routine, as well as her main motivations and difficulties.

To highlight the critical importance of Sandra's work as a materials collector and the potential inherent in each citizen when describing their daily tasks, we can pose the following question: "*When you sell your products, how much does one kilogram of the chosen materials cost?*" (researcher). The participant's response was:

> *Cardboard is twenty cents, plastic (the mixed type I mentioned) is fifty cents, PET (Polyethylene Terephthalate) is one real, aluminum cans are six reais, copper is 20 to 25 reais, and metal is ten reais. Aluminum blocks are priced at three reais.* (Sandra).

We noticed a certain shyness during the interaction with the participant when the researcher asked: "*When do you use calculations (addition, subtraction, division, and multiplication) in your daily life? Comment and provide examples of how you perform these mathematical operations.*" Sandra answered: "*Oh, every day. I already have an idea of what's inside and use it for everything, you know*." (Sandra).

Observing the critical perspective regarding mathematics education from the recyclable materials collector, it becomes evident that Sandra expresses inquiries at various moments regarding the application of critical mathematics education in her narratives. Even without clarity on how to increase her earnings, when questioned, she acknowledges a lack of understanding of critical mathematics education.

4.2 Follow-up

During Sandra's follow-up, we observed and understood her daily work routine, main motivations, and difficulties. In these meetings, Sandra showed interest in understanding the follow-up results and how to improve her daily income. In general, the moments of the meetings were marked by emotion and the desire for a better life.

From the analysis of the collected data, we proposed a mathematical model (as shown in Figure 2) that can be used to estimate the relationship between income and hours worked, assuming Sandra's routine remains like what was observed during the monitoring period. To construct this model, we considered the data collected over 30 days, as outlined in Table 1.

Table 1: Income Configuration

Day	week	Total Earnings (in reais)	Total Collected Product (in kg)	Hours Worked	Earnings per Hour
1º	Tuesday	R$ 32.27	37.200	5	R$ 6.45
2º	Wednesday	R$ 56.37	95.050	6	R$ 9.40
3º	Thursday	R$ 27.56	47.700	5	R$ 5.51
4º	Friday	R$ 12.32	9.200	3	R$ 4.11
5º	Saturday	R$ 10.34	6.700	3.5	R$ 2.95
6º	Monday	R$ 52.41	28.650	4.5	R$ 11.65
7º	Tuesday	R$ 38.40	31.150	3.5	R$ 10.97
8ª	Tuesday	R$ 38.38	56.600	6.5	R$ 5.90
9ª	Wednesday	R$ 57.41	71.200	6	R$ 9.57
10º	Thursday	R$ 48.98	83.180	5.5	R$ 8.91
11º	Friday	R$ 69.13	112.700	4.5	R$ 15.36
12º	Saturday	R$ 28.65	42.000	4.5	R$ 6.37
13º	Monday	R$ 59.60	94.200	6	R$ 9.93
14º	Tuesday	R$ 58.02	80.200	8.5	R$ 6.83
15º	Wednesday	R$ 42.49	64.650	6	R$ 7.08
16º	Thursday	R$ 54.48	87.980	5.5	R$ 9.91
17º	Friday	R$ 48.90	75.800	4	R$ 12.23
18º	Saturday	R$ 41.00	53.200	5.5	R$ 7.45
19º	Monday	R$ 58.00	70.800	6	R$ 9.67
20º	Tuesday	R$ 45.10	57.500	6	R$ 7.52
21º	Wednesday	R$ 41.20	48.000	5.5	R$ 7.49
22º	Thursday	R$ 29.00	42.800	7	R$ 4.14
23º	Friday	R$ 53.50	71.200	6.5	R$ 8.23
24º	Monday	R$ 71.10	126.800	6	R$ 11.85
25º	Tuesday	R$ 43.00	65.800	5	R$ 8.60
26º	Wednesday	R$ 45.00	58.300	5	R$ 9.00
27º	Thursday	R$ 35.88	43.960	6	R$ 5.98
28º	Friday	R$ 88.04	113.700	7	R$ 12.58
29º	Saturday	R$ 78.20	101.500	4	R$ 19.55
30º	Monday	R$ 48.23	111.800	5	R$ 20.09

Source: Developed by the authors

The data presented in Table 1 allowed us to create a mathematical model based on linear regression that can serve as a decision-making tool for Sandra. We expected this mathematical model to be used, based on hours worked and daily earnings, to estimate earnings based on the

number of hours worked or to gain insight into potential earnings.

Figure 1 includes a QR code and a hyperlink that leads to an explanatory video, complete with examples, demonstrating how we derived the mathematical model for Sandra using Excel.

Figure 1: Video – How to Find the Mathematical Model

https://www.youtube.com/watch?v=ud6HLF8Semg

Source: Developed by the author

With the assistance of linear regression and the Pearson correlation coefficient, we were able to identify a scenario with multiple possibilities. For example, when working five hours daily, Sandra earned an average of R$ 29.91, although she could earn R$ 44.82. These data highlight that Sandra is earning 33.27% less than she could, emphasizing the unpredictability of this activity.

After the daily monitoring, we delved into understanding her earnings and how they might impact her future income. Following data analysis, we formulated the linear regression model, resulting in $y = 5.6871x + 16.388$. This model represents the ideal earnings scenario for participant Sandra based on the data collected over the 30-day monitoring period.

The Pearson Correlation Coefficient, with a value of 0.388, indicates a relatively low correlation between "hours worked per day" and "income." variables This result suggests that an increase in Sandra's working hours on a specific day does not necessarily lead to proportionally higher earnings compared to days with fewer working hours.

Considering these findings and the need for decision-making possibilities, we recognize that critical mathematics education advocates for interactions based on equality and mutual respect. This premise is essential for developing critical and autonomous individuals (Skovsmose, 2001).

Paulo Freire (1967), on the other hand, asserts that education should be a dialogical and emancipatory process. In this paradigm, the teacher does not merely transmit knowledge but acts as a mediator who facilitates dialogue among students. Through this verbal exchange, learners construct an informal community of knowledge, learning from one another.

The participant expressed interest in understanding the application of critical mathematics education in her activities and reflected on the critical thinking of some waste pickers regarding mathematical operations in their work. Thus, we recognize that critical mathematics education is essential for waste pickers to make decisions based on statistical data. We observed the difficulties faced by waste pickers and the importance of mathematics education in decision-making related to work and employment contracts.

Considering the trajectory of the participant and the words of Skovsmose (2001) and Freire (1967), we understand that their contributions, whether in formal or informal settings, are relevant for decision-making in diverse environments.

In this way, the research encourages reflection on a society that needs equity among its members and recognizes that social inequality and poor income distribution contribute to social vulnerability.

4.3 Final Meeting – Perception or Disappointment?

The final meeting with Sandra took place after a month of monitoring and aimed to present her with the results of the statistical analysis conducted and the proposed mathematical model (as shown in Figure 2) to assist her in decision-making.

During the meeting, the researcher provided Sandra with a card (Figure 2), offering suggestions to enhance the organization of her work and support her decision-making process. Sandra expressed interest in understanding and applying the proposed model, demonstrating a strong desire for improvements in her life. She was highly engaged in seeking ways to increase her income, especially considering her retired status, and improve her family's quality of life.

Figure 2: Decision Support Card

Horas	Valores
1	R$ 22,08
2	R$ 27,76
3	R$ 33,45
4	R$ 39,14
5 (Desejado)	R$ 44,82
6	R$ 50,51
7	R$ 56,20
8	R$ 61,88
9	R$ 67,57
10	R$ 73,26
11	R$ 78,95 (Desejado)
12	R$ 84,63
13	R$ 90,32
14	R$ 96,01
15	R$ 101,69
16	R$ 107,38
17	R$ 113,07
18	R$ 118,76
19	R$ 124,44
20	R$ 130,13
21	R$ 135,82

Source: Elaborated by the author"

In the final meeting, the participant's remarks revealed that she learns from colleagues and contributes to society in her work, particularly in collecting objects and recycling products. Inspired by Freire's ideals (1967), we can reflect on liberating education aimed at communities in vulnerable situations. In this study, we emphasize that liberating educational approaches enhance the educational engagement of urban populations and are intrinsically linked to the flexibility of their consciousness.

Surprised by the results, Sandra questioned whether she could modify her current income by opting for other materials. We clarified that the card (Figure 2) represents the model with data collected over a month of monitoring, and any alternative decision could indeed influence the outcome. Sandra then adds: "*This paper (card) will help choose different products, you see? I think I'll work a few more hours, maybe change from five to six or six and a half.*" We noticed her need for change, coupled with the responsibility of making new choices regarding decision-making.

The final meeting resulted from an investigative work carried out with great dedication, respect, and commitment. It served as a space for reflection for the participant, who could better understand the importance of mathematics education in her activity. The researcher realized that the proposed model could be applied to other recyclable material collectors, allowing for improved decision-making regarding working hours and, consequently, enhancing their lives.

5 Final considerations

We present various initial and concluding insights related to the journey undertaken with the recyclable waste collector from the São Paulo countryside. Some initial observations include the importance of providing equal opportunities to all individuals, awareness of existing barriers, the search for innovative and inclusive solutions, and understanding the needs and challenges faced by socially vulnerable people.

The study concluded that critical mathematics education can benefit recyclable waste pickers when making decisions based on statistical data. The application of the mathematical model enabled Sandra to make more informed and consistent choices in her decision-making, thereby expanding her income possibilities.

The research used linear regression to estimate the relationship between revenue and working hours for a recyclable materials collector in a city in the São Paulo countryside. Through this study with the recyclable materials collector Sandra, it became evident that the estimated relationship between revenue and working hours can exhibit significant variations, making collecting challenging and uncertain for these workers.

The mathematical model proposed by the researcher for Sandra serves as a decision-making tool to estimate revenue based on working hours. Thus, awareness of the financial impact can contribute to more effective reflection, communication, and public policies. It also highlights the societal and environmental importance of this type of work.

The results and investigation presented in this study provide an understanding of the difficulties faced by recyclable materials collectors, and underscore the significance of mathematics education in their decision-making regarding work.

Furthermore, this research gives voice to an often undervalued activity in society and prompts reflection on social inequality and vulnerability that affects the lives of many recyclable materials pickers.

As for final insights, we recognize that small changes and adaptations can make a significant difference in the lives of these individuals. The dialogue between popular and scientific knowledge is crucial for developing more effective educational practices. Additionally, this research emphasizes the decisive role of knowledge in constructing critical and transformative education. By considering the contributions of recyclable materials collectors, we can analyze how the interplay between popular and scientific knowledge shapes society.

The final perceptions include the realization that small changes and adjustments can make a significant difference in the lives of these individuals. The importance of dialogue between popular and scientific knowledge for the development of more effective educational practices is highlighted. Additionally, a powerful source of knowledge is identified as equally influential in shaping critical and transformative education. Thus, the research also concludes that through the contribution of recyclable waster collectors, we can analyze how the relationship between popular and scientific knowledge contributes to the constitution of society.

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