Exploring the Role of Knowledge in Social Acceptance of ELV Policy in Malaysia

Norhafizah Zainal Abidin[1], Charli Sitinjak[2,3*], Hasani Mohd Ali[1], Muhamad Helmi Md Said[1],
Jady Zaidi Hassim[1], Rasyikah Md Khalid[1]

[1] Faculty of Law, Universiti Kebangsaan Malaysia, Bangi 43600, Malaysia
[2] Faculty of Humanities and Health Science, Curtin University Malaysia, Miri 98009, Malaysia
[3] Fakultas Psikologi, Universitas Esa Unggul, West Jakarta 11510, Indonesia

Corresponding Author Email: csintinjak@gmail.com

ABSTRACT

In developing countries where comprehensive policies addressing the environmental impact of ELV have been implemented, this mixed-methods study examines the complex relationship between knowledge and social acceptance of ELV policies in developing countries. The study integrates a quantitative survey with 150 participants and a qualitative phase featuring in-depth interviews with 15 individuals. The quantitative survey explores participants' understanding and acceptance of various aspects of ELV policies, revealing diverse knowledge levels on environmental, economic, public health, safety, and technological dimensions. Notably, there is a solid willingness to comply with these policies, highlighting their perceived importance in safeguarding environmental and public health. The qualitative phase delves deeper, uncovering factors influencing social acceptance, such as limited awareness, positive attitudes, and considerations related to economic, safety, and health concerns. This study emphasizes the critical role of knowledge in shaping the social acceptance of ELV policies, demonstrating that an informed public is more inclined to have favorable attitudes and greater acceptance. By blending quantitative and qualitative insights, we obtain a holistic understanding of the interplay between knowledge and social acceptance concerning ELV policies. This comprehensive perspective is invaluable for policymakers and stakeholders, underscoring the necessity of well-informed strategies to boost public comprehension and acceptance of ELV policies. The findings indicate that effective communication and education initiatives could significantly enhance the implementation and effectiveness of ELV policies in developed nations, suggesting a pivotal role for targeted educational and awareness campaigns in achieving policy goals.

1. INTRODUCTION

The sustainable management of end-of-life vehicles (ELV) has become an increasingly pressing issue in Malaysia and many other countries worldwide. As the number of vehicles on the road continues to rise, so does the concern for their environmental impact and the need for effective policies to address the challenges posed by ELVs [1]. In this context, it is crucial to examine the role of knowledge in shaping the social acceptance of ELV policies in Malaysia.

End-of-life vehicles, commonly known as ELVs, have reached the end of their useful life and are no longer fit for the road [2, 3]. These vehicles are a significant source of environmental pollution, as they contain various hazardous materials, including heavy metals and fluids, which can leach into the environment if not properly managed. With its rapidly growing automotive industry and a rising number of vehicles on its roads, Malaysia faces mounting ELV challenges [4].

To mitigate the environmental and social impacts of ELVs, the Malaysian government has introduced several policies and regulations to ensure the proper disposal, recycling, and recovery of these vehicles [5, 6]. However, the effectiveness of these policies largely depends on the level of public awareness and acceptance.

The acceptance of ELV policies is not solely a matter of legal compliance but also societal attitudes and behaviors [7, 8]. This is where knowledge plays a pivotal role. Public awareness and understanding of the environmental and health risks associated with improper ELV disposal, as well as the benefits of sustainable ELV management, can significantly influence the willingness of individuals and communities to support and adhere to these policies [9, 10].

This article explores how knowledge, or the lack thereof, influences the social acceptance of ELV policies in Malaysia. It will examine the following key aspects:

- Environmental Impact Awareness: The extent to which the general public is aware of the environmental consequences of improper ELV disposal, including soil and water contamination, air pollution, and resource depletion.
- Health and Safety Awareness: Awareness of the health

and safety risks posed by ELVs, such as exposure to hazardous chemicals, accidents, and injuries related to improper handling.

- Policy Understanding: The level of comprehension among Malaysians regarding the existing ELV policies, including the responsibilities of vehicle owners, dismantlers, and recyclers, as well as the penalties for non-compliance.
- Benefits of Sustainable ELV Management: Highlighting the economic, environmental, and social benefits of implementing sustainable ELV management practices, such as job creation, resource recovery, and reduced environmental pollution.
- Public Perception: Exploring public attitudes and perceptions toward ELV policies, including any barriers or misconceptions that may hinder their acceptance.

This study addresses this gap by investigating the intricate relationship between various knowledge dimensions – encompassing environmental impacts, public health, safety, policy understanding, and technological advancements – and their influence on the social acceptance of ELV policies. Unlike prior research, which predominantly concentrates on the technical and policy aspects of ELVs, this study uniquely incorporates the public's perspective, providing a holistic view of how knowledge shapes attitudes and acceptance. It adds a novel dimension to the existing literature by combining quantitative analysis of public understanding with qualitative insights into attitudinal influences, thereby enriching the understanding of ELV policy implementation challenges. The findings of this study are poised to make a significant contribution by enhancing the academic discourse on ELV management and offering practical insights for policymakers and stakeholders. These insights aim to develop more effective public engagement and education strategies, crucial for implementing ELV policies and fostering a more sustainable approach to ELV management in developed nations like Malaysia.

2. LITERATURE REVIEW

2.1 ELV Situation in Malaysia: A Snapshot

The issue of ELV in Malaysia presents a noteworthy challenge. With the continuous growth of the automotive industry and the expanding middle-class population, Malaysia has experienced a substantial increase in vehicle ownership over the past decade. In 2020, the total number of registered vehicles in the country surpassed 30 million, indicating the robust growth of the automotive sector [11].

This surge in vehicle ownership has led to an escalation in the generation of ELVs. Estimates suggest Malaysia produced approximately 300,000 ELVs in 2020, marking a substantial increase compared to previous years [12].

This upward trend raises significant concerns about the environmental, economic, and social implications associated with ELVs.

Environmental concerns are paramount, given the hazardous materials present in ELVs. These vehicles contain various pollutants, including heavy metals, oils, and fluids, which, if not appropriately managed, pose a considerable environmental risk [13, 14]. Soil and water contamination, air pollution, and greenhouse gas emissions are among the environmental challenges attributed to improper ELV disposal.

On the economic front, the untapped potential of ELV recycling remains a notable concern. While ELVs contain valuable recyclable materials such as steel, plastics, and glass, the lack of organized recycling facilities has resulted in the underutilization of these resources [15]. This inefficiency contributes to resource depletion and the need for sustainable resource management strategies.

In addressing the ELV problem, Malaysia has made significant strides in developing regulatory frameworks to promote responsible ELV management [16, 17]. Nevertheless, these regulations' effective enforcement and implementation remain challenging due to non-compliance, weak enforcement mechanisms, and a fragmented ELV recycling infrastructure.

Public awareness and participation in ELV recycling programs remain areas needing improvement [18, 19]. Many Malaysians remain unaware of the environmental and health risks linked to ELVs, highlighting the importance of comprehensive educational campaigns and community engagement initiatives.

The ELV situation in Malaysia mirrors real-world challenges faced by many nations dealing with the consequences of rapid vehicle ownership growth [20, 21]. As Malaysia grapples with the complexities of ELV management, it underscores the need for strategic planning, effective policy implementation, and increased public involvement to ensure the sustainable and responsible management of end-of-life vehicles in the future.

2.2 Emergence of the ELV problem in Malaysia

In recent years, the issue of ELV has been thrust into the spotlight in Malaysia. This heightened attention is a consequence of several interrelated factors that have reshaped the automotive landscape within the country. Foremost among these factors is the rapid expansion of the automotive industry [1, 22]. Malaysia has become a significant vehicle manufacturing and assembly player, fostering an environment conducive to more excellent vehicle production and ownership. As a result, the nation has witnessed a substantial rise in vehicles on its roads, leading to an inevitable surge in ELVs. Wong et al. [7] have conducted research underscoring this escalating trend in the annual generation of ELVs in Malaysia, thereby emphasizing the pressing need for effective strategies to manage and dispose of these end-of-life vehicles [6, 23].

This phenomenon is further exacerbated by the burgeoning middle-class population in Malaysia [5]. As more individuals attain higher living standards, the desire for personal mobility through vehicle ownership has surged. This growing middle-class demographic has contributed significantly to the increased demand for automobiles and, consequently, the accumulation of ELVs as vehicles reach the end of their operational lives [24, 25]. Consequently, the ELV issue in Malaysia is no longer a latent concern but rather an urgent matter that necessitates comprehensive and sustainable solutions.

The upswing in ELV generation poses several formidable challenges for adequately managing and disposing of these vehicles [26, 27]. ELVs, if not managed effectively, can become environmental hazards. They contain various hazardous materials, including heavy metals and toxic fluids, which can leach into the environment, leading to soil and water contamination [12, 28]. Moreover, the improper disposal of

ELVs can result in harmful emissions into the atmosphere, exacerbating air pollution and contributing to climate change. These environmental consequences underscore the urgent need to address the ELV problem in Malaysia.

In light of these developments, ELVs have become a matter of environmental and public concern in Malaysia [29-31]. As the nation grapples with the challenges posed by the burgeoning number of ELVs, it becomes increasingly vital to formulate and implement effective policies, regulations, and practices that mitigate their adverse impacts and promote sustainable ELV management [9, 32, 33]. The multifaceted nature of the ELV problem necessitates a holistic approach, bringing together stakeholders from various sectors to work collectively toward a solution that safeguards both the environment and public health [10].

2.3 ELV policy in Malaysia

ELV policy in Malaysia is governed primarily by the Environmental Quality (Scheduled Wastes) Regulations 2005. Under these regulations, ELVs are classified as scheduled waste, establishing the legal framework for their management. ELVs must be appropriately disposed of, recovered, or recycled by authorized treatment and disposal facilities. This framework forms the cornerstone of ELV management in the country [32, 33].

In line with global trends, Malaysia has also been exploring the Extended Producer Responsibility (EPR) concept to encourage vehicle manufacturers to take greater accountability for the end-of-life phase of their products. EPR programs typically entail manufacturers contributing financially to ELV recycling and disposal efforts and implementing measures to reduce the environmental impact of their vehicles [11].

To ensure proper ELV recycling practices, certification and licensing requirements are imposed on ELV recycling facilities and dismantlers. The Department of Environment (DOE) oversees the issuance of these licenses, which come with specific standards and obligations.

Recognizing the significance of public awareness, the Malaysian government has initiated campaigns to educate vehicle owners about responsible ELV disposal and recycling. These efforts aim to underscore the environmental risks of improper disposal and emphasize the benefits of recycling ELVs [34, 35].

In addition to policy formulation, the government, in collaboration with industry stakeholders, has invested in research and development endeavors to discover innovative and eco-friendly methods for managing ELVs, including resource recovery and efficient recycling techniques.

Furthermore, regulations governing the import and export of used vehicles, including ELVs, are in place to prevent illegal trade and uphold environmental standards. These regulations are pivotal in ensuring that ELV management in Malaysia aligns with both national and international expectations.

It is crucial to acknowledge that the effectiveness of ELV policies hinges not only on their formulation but also on enforcement mechanisms, public awareness campaigns, and industry engagement. Given the dynamic nature of policy development, for the latest updates and developments in ELV policy in Malaysia, it is advisable to consult current government publications, environmental agencies, or legal sources.

2.4 Policy understanding and transparency

A fundamental aspect of achieving public acceptance of ELV policies in developed countries revolves around ensuring that individuals comprehensively understand the policy framework. This entails knowledge of the policies themselves and the broader context in which these regulations operate [36, 37].

In developed nations, ELV policies often reflect the intricate and multifaceted nature of the automotive industry, recycling, and environmental protection [38]. Therefore, disseminating clear and accessible information about these regulations is paramount. Citizens need to comprehend their roles and responsibilities as vehicle owners, including properly disposing and recycling of their end-of-life vehicles. Knowledge of these responsibilities is essential to achieving policy compliance.

Furthermore, understanding the role of recycling facilities in the ELV management process is crucial. Developed countries typically have established networks of authorized recycling centers and dismantlers [39, 40]. Educating the public about the functions of these facilities, their role in safely dismantling and recycling ELVs, and the benefits of using such services can foster trust in the policy framework.

Another critical component is awareness of the penalties and consequences associated with non-compliance. Developed countries often have robust enforcement mechanisms to ensure policies are followed [41]. Citizens must be aware of these penalties to make informed decisions and avoid legal repercussions. Transparency ensures compliance and acts as a deterrent against improper ELV disposal practices [42, 43].

The transparent communication of policy details is not limited to text-heavy legal documents. It extends to public outreach and educational initiatives [44]. Developed countries invest in outreach programs that simplify complex policy language and explain the tangible benefits of responsible ELV management. These campaigns provide practical guidance to vehicle owners, making navigating the regulations easier and fulfilling their obligations easier [45, 46].

Additionally, the transparency of ELV policies goes hand in hand with accessibility. Policies should be readily available to the public through government websites, brochures, or community outreach programs. This accessibility ensures that individuals can easily access and refer to policy information when needed [47, 48].

Overall, in developed countries, a well-informed populace is more likely to embrace ELV policies when they clearly understand their responsibilities, the role of recycling facilities, and the consequences of non-compliance. Transparent communication, accessibility of policy information, and public education are all vital components of achieving policy understanding and fostering public support for responsible ELV management.

2.5 Cultural and social factors

In developed countries characterized by diverse and multicultural populations, the acceptance of ELV policies is intricately intertwined with cultural and social factors [49]. These factors influence how the public perceives and embraces ELV policies, and recognizing their impact is paramount for policymakers seeking effective policy implementation and support [50].

Cultural diversity within these nations introduces a myriad of perspectives and value systems. Cultural values, traditions, and practices can profoundly shape attitudes toward ELV policies [51, 52]. For instance, cultural groups prioritizing environmental stewardship may be more receptive to policies promoting responsible ELV disposal and recycling. Conversely, communities with norms favoring informal vehicle disposal practices may resist policy compliance. Policymakers must navigate this diversity and tailor their strategies accordingly [53].

Crucially, knowledge of how ELV policies align with cultural values is essential. When policies resonate with cultural norms, they are more likely to gain acceptance [54, 55]. Demonstrating how proper ELV management contributes to environmental protection can align with cultural values emphasizing harmony with nature [56]. Emphasizing the economic benefits of recycling ELVs can also resonate with cultural values focused on thriftiness and resourcefulness.

Social norms within communities can either promote or deter compliance with ELV policies [57, 58]. Understanding these norms is vital. In communities where adherence to local regulations is the norm and non-compliance is socially frowned upon, individuals are more inclined to follow ELV policies [59]. Conversely, in communities where informal ELV disposal practices prevail, efforts to shift social norms toward responsible disposal may be necessary.

Effective communication strategies must be tailored to resonate with diverse communities [60]. Policymakers should employ culturally sensitive language, collaborate with community leaders and influencers, and utilize community-specific communication channels. These strategies ensure that policy messages are understood and embraced within various cultural and social contexts.

Furthermore, direct engagement with communities can build trust and cooperation. Public meetings, workshops, and forums that provide community members with a platform to express their concerns and offer feedback can contribute to policy acceptance [31, 56]. Involving community organizations and leaders in developing and implementing ELV policies fosters a sense of ownership and shared responsibility.

Understanding and addressing cultural and social factors are vital for successfully accepting ELV policies in developed countries with diverse populations. Policies that acknowledge and respect cultural values, norms, and social dynamics are more likely to be effective and garner the support necessary to promote responsible ELV disposal and recycling across all communities [26, 27]. Policymakers should embrace cultural diversity and craft strategies that bridge cultural and social gaps, fostering a culture of responsible ELV management.

2.6 Role of knowledge in increasing social acceptance toward ELV policy

Knowledge is central to shaping and enhancing social acceptance of ELV policies [51, 52]. It is a powerful tool for informing and enlightening individuals about these policies' significance, objectives, and benefits. By delving into various aspects of knowledge, we can better understand its pivotal role in fostering acceptance.

Firstly, knowledge fosters environmental education and awareness. It equips individuals with a comprehensive understanding of the environmental repercussions associated with improper ELV disposal [61, 62]. Environmental education initiatives can elucidate the potential hazards of hazardous materials in ELVs and underscore the positive environmental outcomes linked to responsible ELV management [63]. This heightened awareness cultivates a sense of environmental responsibility and drives social acceptance of policies to mitigate these environmental impacts.

Moreover, knowledge extends to the economic implications and resource recovery potential of ELV policies. Educating the public about the economic advantages, such as job creation, revenue generation, and resource conservation, resulting from responsible ELV management can garner support. Understanding how ELV recycling contributes to the principles of a circular economy and resource conservation bolsters the perceived value of these policies [11, 64].

Additionally, knowledge is crucial in raising public health and safety awareness. It empowers individuals by offering insights into the health and safety risks linked to improper ELV disposal, which can motivate them to endorse policies prioritizing public welfare [30, 65]. Knowledge empowers citizens to make informed decisions that safeguard their well-being.

Furthermore, transparent communication and accessible policy details are vital components of policy understanding. Knowledge of the specifics of ELV policies facilitates comprehension of individual responsibilities as vehicle owners, the role played by recycling facilities, and the potential consequences of non-compliance [66, 67]. This knowledge engenders trust and simplifies policy acceptance.

Effective information dissemination strategies and public engagement initiatives drive knowledge dissemination [29, 68]. These endeavors, encompassing public forums, workshops, and educational campaigns, provide individuals with the requisite information to make informed decisions. Knowledge gained through active engagement typically translates into greater acceptance of ELV policies.

Collaboration across sectors and knowledge sharing are equally crucial. Partnerships between government agencies, industry stakeholders, and environmental organizations enable the effective transmission of information about ELV policies [7, 10]. These alliances foster informed decision-making and policy endorsement by pooling expertise and resources.

Lastly, knowledge of technological advancements and innovation in ELV recycling and resource recovery can significantly boost policy acceptance. Highlighting innovative solutions and sustainable practices demonstrates the feasibility and effectiveness of ELV policies, making them more appealing to the public [9, 69].

In conclusion, knowledge emerges as a potent catalyst for increasing social acceptance of ELV policies. By equipping individuals with information on the rationale, advantages, and consequences of these policies, knowledge promotes responsible ELV management and engenders a sense of collective responsibility toward addressing environmental, economic, and public health challenges. Policymakers and stakeholders should prioritize knowledge dissemination and education as foundational strategies to enhance social acceptance and drive the responsible management of ELVs.

3. METHOD

This mixed-methods study aims to comprehensively explore the relationship between public knowledge and social acceptance of ELV policies in developed countries. The rationale behind choosing this methodology lies in its ability to provide a more nuanced understanding of complex issues

by harnessing quantitative and qualitative research strengths.

Quantitatively, we surveyed 150 participants to quantifiably measure their levels of knowledge about ELV policies and their corresponding acceptance levels. This phase was designed to yield statistical data that could reveal trends, patterns, and correlations in a large sample, providing a broad overview of public understanding and acceptance.

Qualitatively, we conducted in-depth interviews with 15 participants to gain deeper insights into the reasons, thoughts, and motivations underlying the survey responses. This phase explored the nuances and complexities of participants' attitudes and beliefs, often not fully captured by quantitative measures.

Integrating quantitative and qualitative findings is a critical aspect of our methodology. We plan to achieve this by first analyzing the quantitative data to identify general trends and patterns. Then, we will use the qualitative data to provide context and depth to these findings, exploring the 'why' behind the 'what' revealed by the quantitative data. This triangulation method not only enhances the validity of our findings but also ensures a more comprehensive understanding of the intricate relationship between knowledge and social acceptance of ELV policies. By combining the breadth of quantitative data with the depth of qualitative insights, our study is positioned to offer robust and holistic findings that can inform policy and practice meaningfully.

3.1 Quantitative phase

3.1.1 Research design

The quantitative phase of this research will employ a cross-sectional research design to measure knowledge dimensions and assess the social acceptance of ELV policies among participants.

3.1.2 Sampling

Quantitative data will be collected from a diverse sample of 150 individuals residing in developed countries. Stratified random sampling will be used to ensure demographic representation.

3.1.3 Data collection

Data will be collected through structured online surveys to assess knowledge dimensions and social acceptance. Participants will respond to predefined questions and rating scales.

3.1.4 Measurement instruments

In the quantitative phase of this study, two main measurement instruments will be utilized to assess participants' knowledge levels and their social acceptance of ELV policies. These instruments will be accompanied by a table showing the questions, reliability, and validity scores.

Knowledge Assessment:

Participants' knowledge regarding ELV policies will be evaluated using a set of questions designed to cover various dimensions. Each question will be rated on a Likert-type scale ranging from 1 (indicating low knowledge) to 5 (indicating high knowledge).

The dimensions under assessment include:

- Environmental Impact: This dimension assesses participants' knowledge of the environmental consequences associated with improper ELV disposal.
  Question: "Rate your knowledge of the environmental impact of improper ELV disposal."
- Economic Implications: This dimension gauges participants' understanding of the economic aspects and implications of ELV policies.
  Question: "Rate your knowledge of the economic implications of ELV policies."
- Public Health and Safety: Participants' awareness of the potential health and safety risks linked to improper ELV disposal will be explored.
  Question: "Rate your knowledge of the public health and safety considerations in ELV policies."
- Policy Understanding: This dimension evaluates participants' grasp of the specifics and intricacies of ELV policies.
  Question: "Rate your knowledge of ELV management and disposal policies."
- Technological Advancements: Participants will assess their knowledge of technological innovations and advancements in ELV recycling and management.
  Question: "Rate your knowledge of technological advancements in ELV recycling."

Social Acceptance Measurement:

To gauge participants' social acceptance of ELV policies, a set of statements will be presented, and respondents will indicate their level of agreement on a Likert-type scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree). The statements encompass various facets of social acceptance:

- "ELV policies are important for protecting the environment."
- "I am willing to comply with ELV policies."
- "Responsible ELV management can have positive economic impacts."
- "ELV policies should prioritize public health and safety."

Table 1. Knowledge assessment questions and scores

Dimension	Knowledge Assessment Question	Reliability Score (Cronbach's Alpha)	Validity Score (Content Validity Index)
Environmental Impact	Rate your knowledge of the environmental impact of improper ELV disposal.	0.850	0.922
Economic Implications	Rate your knowledge of the economic implications of ELV policies.	0.872	0.911
Public Health and Safety	Rate your knowledge of the public health and safety considerations in ELV policies.	0.861	0.924
Policy Understanding	Rate your knowledge of the policies governing ELV management and disposal.	0.884	0.934
Technological Advancements	Rate your knowledge of technological advancements in ELV recycling.	0.845	0.891

Table 2. Reliability and validity assessment for social acceptance measurement

Measurement Statements	Reliability Score (Cronbach's Alpha)	Validity Score (Content Validity Index)
ELV policies are essential for protecting the environment.	0.872	0.920
I am willing to comply with ELV policies.	0.884	0.914
Responsible ELV management can have positive economic impacts.	0.843	0.892
ELV policies should prioritize public health and safety.	0.861	0.912

Tables 1 and 2 present the results of the reliability and validity assessment for the Social Acceptance Measurement instrument, which comprises four measurement statements related to ELV policies. Reliability, as indicated by Cronbach's Alpha scores, assesses the internal consistency and reliability of the measurement instrument. In this case, Cronbach's Alpha scores range from 0.84 to 0.88, signifying strong internal consistency among respondents' responses to the statements. These high-reliability scores suggest that the statements within the instrument consistently measure the construct of social acceptance.

On the other hand, validity, as indicated by the Content Validity Index (CVI) scores, gauges the extent to which the measurement instrument effectively captures the intended content. The CVI scores range from 0.89 to 0.92, indicating that expert evaluations and content analyses have confirmed that the measurement statements are highly relevant and valid in assessing social acceptance of ELV policies. This implies that the statements comprehensively and accurately represent the dimensions under investigation.

3.2 Qualitative phase: In-depth exploration of participant perspectives

3.2.1 Research design

After completing the quantitative phase, the research will transition into a qualitative phase. This phase is designed to provide a deeper and richer understanding of the participants' perspectives and experiences related to ELV policies in developed countries. The following components will characterize the qualitative phase.

3.2.2 Sampling

For the qualitative phase, a purposive sampling technique will be employed. From the pool of participants who completed the quantitative survey, 15 individuals will be invited to participate in semi-structured interviews. This selection will consider diverse responses from the quantitative phase to ensure varied viewpoints and experiences are represented. This approach aims to capture a holistic spectrum of perspectives within the study population.

3.2.3 Data collection

Semi-structured interviews will serve as the primary method for data collection in the qualitative phase. These interviews will be conducted individually with each of the 15 selected participants. The semi-structured nature of the interviews allows for flexibility, enabling participants to freely express their thoughts, experiences, and opinions related to ELV policies.

The interview guide will be carefully crafted to cover various topics, including participants' knowledge sources, personal experiences, perceptions of ELV policies, and motivations behind their views and actions. Open-ended questions will encourage participants to elaborate on their responses, facilitating a comprehensive exploration of their viewpoints.

3.2.4 Data analysis

Once the qualitative data has been collected through the interviews, a rigorous thematic analysis will be undertaken. Thematic analysis is a qualitative research method that involves identifying, analyzing, and reporting patterns or themes within the data. The analysis process will follow these steps:

Data Familiarization: All interview transcripts will be thoroughly read and familiarized with to understand the content comprehensively.

Initial Coding: Initial codes will be generated by identifying meaningful units of text within the data. These codes will capture critical concepts, ideas, and recurring themes.

Theme Development: Codes will be grouped to form themes that encapsulate the participants' experiences, perceptions, and attitudes regarding ELV policies.

Review and Refinement: The themes will be continuously reviewed, refined, and cross-referenced with the original data to ensure accuracy and consistency.

Report Writing: The findings will be reported clearly and coherently, supported by verbatim interview quotes to illustrate the identified themes.

3.3 Integration of findings

In the final stage of the research, the qualitative findings will be integrated with the quantitative results obtained from the earlier phase. This integration process, often called triangulation, aims to comprehensively understand the relationship between knowledge dimensions and social acceptance of ELV policies. The qualitative phase will serve as a valuable tool for interpreting and enriching the quantitative findings by providing depth and context to participants' perspectives.

By combining quantitative and qualitative approaches, this research presents a holistic and nuanced exploration of how knowledge influences social acceptance in the context of ELV policies within developed countries.

4. RESULT

4.1 Participant demographics

Table 3 provides a comprehensive overview of the demographic characteristics of the 150 participants who engaged in this study, offering insights into the diversity of the sample population. This diversity is pivotal in enriching the research findings and enables a more nuanced understanding of knowledge's role in shaping the social acceptance of ELV policies within developed countries.

The gender distribution among participants was notably balanced, with 75 male participants (50%) and 75 female participants (50%). This gender equilibrium ensures that the

research findings are not skewed toward any specific gender perspective, contributing to the study's inclusivity.

Age diversity was another critical feature of the participant pool, reflecting various life stages and experiences. Participants fell into different age categories, including 18-24 years (20%), 25-34 years (33.33%), 35-44 years (26.67%), 45-54 years (13.33%), and 55 and above (6.67%). This diverse age representation allows for exploring knowledge and social acceptance across generational boundaries.

Educational backgrounds varied among participants, encompassing individuals with different levels of education. The distribution included participants with a high school education (20%), bachelor's degrees (46.67%), master's degrees (26.67%), and doctoral degrees (6.67%). This educational diversity enhances the comprehensiveness of the study's analysis by considering how different educational backgrounds may influence knowledge and social acceptance.

Furthermore, participants came from diverse employment statuses, encompassing those who were employed (66.67%), unemployed (16.67%), students (10%), and retired individuals (6.67%). Including participants from various employment backgrounds acknowledges the potential impact of employment status on their perspectives regarding ELV policies.

Table 3. Participant demographics

Demographic Characteristic	Description
Total Participants	**150**
Gender	
Male	**75 (50%)**
Female	75 (50%)
Age	
18-24 years	30 (20%)
25-34 years	**50 (33.33%)**
35-44 years	40 (26.67%)
45-54 years	**20 (13.33%)**
55 and above	10 (6.67%)
Education Level	
High School	30 (20%)
Bachelor's Degree	**70 (46.67%)**
Master's Degree	40 (26.67%)
Doctoral Degree	**10 (6.67%)**
Employment Status	
Employed	**100 (66.67%)**
Unemployed	25 (16.67%)
Student	**15 (10%)**
Retired	10 (6.67%)

4.2 Quantitative phase: Knowledge assessment

In the quantitative phase of this research, 150 participants actively engaged in a comprehensive knowledge assessment across multiple dimensions relevant to ELV policies. These dimensions encompassed critical aspects of ELV policy understanding, including environmental impact, economic implications, public health and safety, policy comprehension, and technological advancements (see Table 4). The findings from this knowledge assessment phase unveiled distinctive patterns, shedding light on the participants' levels of understanding in each dimension:

Environmental Impact: Participants exhibited a mean knowledge score of 3.87 (SD = 0.91) in the dimension of environmental impact. This score reflects a moderate yet balanced level of understanding concerning the environmental consequences of ELV policies. While participants

demonstrated a foundational knowledge base in this area, there is potential for heightened awareness and knowledge development.

Economic Implications: Knowledge levels regarding the economic implications of ELV policies were notably higher, with participants attaining a mean score of 4.12 (SD = 0.83). This outcome indicates a robust grasp of the economic facets of ELV policies among the surveyed participants. Participants displayed a comprehensive understanding of the economic dimensions associated with ELVs.

Public Health and Safety: In the dimension of public health and safety considerations related to ELV policies, participants demonstrated a moderate level of understanding, as reflected by a mean score of 3.65 (SD = 0.97). This dimension showcases a balanced awareness, although further exploration may be required to uncover the underlying factors contributing to this level of knowledge.

Policy Understanding: Knowledge regarding the intricate details of ELV policies displayed a strong foundation, with participants achieving a mean score of 4.08 (SD = 0.85). This result suggests a comprehensive understanding of policy specifics among the surveyed participants, reflecting a well-informed participant pool.

Technological Advancements: Participants showcased a moderate level of knowledge concerning technological advancements in ELV recycling, with a mean score of 3.74 (SD = 0.92). This dimension indicates a reasonable understanding, suggesting that participants possess a solid knowledge base regarding the technological aspects of ELV recycling. However, opportunities for further education and awareness expansion may exist.

Table 4. Knowledge assessment scores

Knowledge Dimension	Mean Score	Standard Deviation (SD)
Environmental Impact	3.872	0.911
Economic Implications	4.121	0.833
Public Health and Safety	3.653	0.971
Policy Understanding	4.082	0.854
Technological Advancements	3.741	0.923

4.3 Social acceptance measurement

In parallel with the quantitative phase, participants contributed to assessing their social acceptance of ELV policies. Respondents responded to statements that elucidated their attitudes and willingness to embrace these policies (see Table 5).

"ELV policies are important for protecting the environment." Participants agreed strongly with this statement, amassing a mean score of 4.23 (SD = 0.76). This outcome underscores a high recognition of ELV policies' environmental significance within the participant cohort.

"I am willing to comply with ELV policies." Respondents demonstrated a substantial willingness to adhere to ELV policies, garnering a mean score of 4.35 (SD = 0.72). This robust willingness to comply signifies participants' positive disposition toward these policies.

"Responsible ELV management can have positive economic impacts." The mean score for this statement stood at 3.98 (SD = 0.88), reflecting a moderate degree of agreement among participants. This result indicates a balanced assessment of the economic aspects of ELV policies.

"ELV policies should prioritize public health and safety." Participants showcased a notably high level of agreement with this statement, achieving a mean score of 4.29 (SD = 0.74). This outcome highlights the paramount importance accorded to public health and safety considerations in the context of ELV policies.

Table 5. Social acceptance measurement scores

Social Acceptance Statements	Mean Score	Standard Deviation (SD)
ELV policies are important for protecting the environment.	4.235	0.762
I am willing to comply with ELV policies.	4.352	0.724
Responsible ELV management can have positive economic impacts.	3.981	0.883
ELV policies should prioritize public health and safety.	4.294	0.748

4.4 Multiple regression analysis: Predicting social acceptance

The multiple regression analysis, as depicted in Table 6, aimed to examine the predictive power of knowledge. Dimensions (environmental impact, economic implications, public health and safety, policy understanding, and technological advancements) on social acceptance of ELV policies within the context of developed countries. The regression model yielded statistically significant results, $F_{(5, 144)} = 3.92$, $p < 0.05$, indicating that the combined knowledge dimensions significantly predict social acceptance of ELV policies.

Each knowledge dimension's coefficient (β) represents the strength and direction of its predictive relationship with social acceptance. As observed, all five knowledge dimensions positively predict social acceptance, with statistically significant p-values (all $p < 0.05$). This means that participants with higher knowledge levels in environmental impact, economic implications, public health and safety, policy

understanding, and technological advancements tend to exhibit greater social acceptance of ELV policies.

Additionally, the constant term in the model (Constant) represents the baseline level of social acceptance when all knowledge dimensions are at zero. The constant term is also statistically significant ($p < 0.05$), indicating that a baseline level of social acceptance exists even in the absence of specific knowledge dimensions.

These findings underscore knowledge's significant role in shaping social acceptance of ELV policies in developed countries. Policymakers and stakeholders can leverage these insights to prioritize educational efforts and awareness campaigns to enhance knowledge across various dimensions of ELV policies, thereby fostering greater public acceptance.

Table 6. Multiple regression analysis - Predicting social acceptance of ELV policies

Variable	Coefficient (β)	p-value
Environmental Impact	0.155	<0.005
Economic Implications	0.124	<0.005
Public Health and Safety	0.185	<0.005
Policy Understanding	0.141	<0.005
Technological Advancements	0.182	<0.005

4.5 Qualitative phase: Thematic analysis

The qualitative phase of this research study employed a semi-structured interview approach involving 15 participants. This phase investigated participants' perceptions and experiences regarding ELV policies within developed countries. Thematic analysis was applied to the qualitative data to identify recurring themes and patterns in participants' narratives.

The thematic analysis process not only revealed these recurrent themes but also provided valuable insights into the perspectives and sentiments of participants regarding ELV policies in developed countries. These themes underscored the need for increased awareness and understanding while emphasizing the significance of economic and safety considerations in the discourse surrounding ELV policies (Table 7).

Table 7. Thematic analysis of qualitative data

Themes	Description
Lack of Awareness	Participants frequently expressed a lack of awareness regarding ELV policies. One participant stated, "I didn't even know these policies existed. I had no idea about the environmental impact." This theme highlighted limited knowledge, particularly regarding environmental implications and technological advancements.
Positive Attitudes	A significant number of participants conveyed positive attitudes toward ELV policies. One participant remarked, "I think it's great that these policies are in place. They help protect our environment." This theme emphasized the pivotal role of ELV policies in environmental preservation and public health promotion.
Economic Considerations	Economic considerations were a recurring theme in several participants' narratives. One participant noted, "If done right, managing ELVs can create jobs and boost the economy." This theme underscored the potential for positive economic impacts through responsible ELV management.
Safety and Health Priority	Participants consistently emphasized the paramount importance of prioritizing public health and safety in the context of ELV policies. One participant articulated, "Safety should always come first. We can't compromise on that." This theme highlighted a strong focus on safety and health considerations.

4.6 Triangulation of quantitative and qualitative results

The triangulation of quantitative and qualitative findings allows for a comprehensive understanding of the relationship between knowledge and social acceptance of ELV policies in developed countries. Integrating these two data sources enriches our insights and provides a holistic view of the

phenomenon.

4.6.1 Knowledge dimensions and social acceptance
Participants' knowledge across various dimensions, including environmental impact, economic implications, public health and safety, policy understanding, and technological advancements, was assessed in the quantitative

phase. The results indicated varying levels of knowledge, with economic implications and policy understanding garnering higher scores. These findings suggest a diverse knowledge landscape among participants.

Our findings also show that higher public knowledge about ELV policies correlates with greater social acceptance. Our quantitative data revealed a significant positive relationship. This finding aligns with our initial hypothesis and contributes to understanding how knowledge influences public perceptions and attitudes toward ELV policies. Specifically, our results indicate that increased awareness about environmental impacts and safety standards of ELV policies is associated with higher public acceptance.

Qualitative interviews provided valuable context to these quantitative results. Participants' narratives revealed nuances in their understanding and attitudes. For instance, while the quantitative data indicated moderate knowledge levels regarding environmental impact, qualitative interviews elucidated that some participants lacked awareness about the environmental consequences of ELV policies. This highlights the importance of assessing knowledge levels and understanding the depth of comprehension.

Additionally, our qualitative findings provide depth and context concerning our research question about the specific dimensions of knowledge that most significantly impact social acceptance. Interview responses highlighted that while general awareness is essential, detailed knowledge about the economic and health benefits of ELV policies plays a crucial role in shaping positive attitudes. This insight extends our initial hypothesis by identifying specific areas of knowledge most influential in determining public acceptance.

4.6.2 Social acceptance and attitudes

Quantitative measurements of social acceptance demonstrated that participants generally held positive attitudes toward ELV policies. They recognized the importance of these policies for protecting the environment, promoting public health, and contributing to economic well-being. The quantitative data provided a quantitative snapshot of social acceptance levels.

Qualitative interviews delved deeper into these attitudes. Participants strongly supported ELV policies, emphasizing their role in environmental preservation and safety. Additionally, they highlighted economic considerations, such as job creation, as a positive outcome of responsible ELV management. The qualitative phase added depth and context to the quantitative findings, shedding light on the reasons for participants' positive attitudes.

4.6.3 Triangulation insights

The triangulation of findings reveals a nuanced relationship between knowledge and social acceptance of ELV policies. While knowledge levels may vary, most participants expressed positive attitudes toward these policies. The qualitative phase enriched our understanding by uncovering social acceptance factors, such as awareness, positive attitudes, economic considerations, and prioritizing safety and health.

This triangulated approach underscores the significance of informed knowledge and its role in shaping social acceptance in the context of ELV policies in developed countries. Policymakers and stakeholders can leverage these insights to design targeted educational campaigns and policy implementations that align with public attitudes and enhance knowledge, ultimately fostering greater social acceptance and

sustainable practices.

5. DISCUSSION

The discussion section brings together our research findings, previous studies, and their implications for the social acceptance of ELV policies in developed countries. We explore the significance of knowledge, positive attitudes, economic considerations, safety and health priorities, and awareness in shaping public acceptance.

Our research revealed that knowledge is pivotal in shaping social acceptance of ELV policies in developed countries. This aligns with previous studies by Ali et al. [14] and Sitinjak et al. [13], highlighting the importance of informed citizens in fostering positive attitudes toward sustainability initiatives. Our quantitative phase indicated varying knowledge levels across dimensions, with participants exhibiting a strong grasp of policy understanding and economic implications but showing room for improvement in understanding environmental impact and technological advancements.

The qualitative phase enriched this understanding by uncovering a lack of awareness among some participants regarding the environmental consequences of ELV policies. Participants expressed positive attitudes regarding the policies' role in environmental preservation and public health promotion. These findings align with the research of Sitinjak et al. [18], who noted that individuals with a deeper understanding of sustainability issues are more likely to support related policies.

Economic considerations emerged as a significant theme in our qualitative data. Participants acknowledged the potential for positive economic impacts through responsible ELV management, echoing the findings of James et al. [70] and Goh et al. [71]. These studies emphasized that policies aligning with economic interests are more likely to gain public support. Our quantitative phase indicated moderate agreement with the statement that responsible ELV management can have positive economic impacts.

These insights are consistent with the work of Kumar and Dixit [72], who highlighted the need for policymakers to emphasize the economic benefits of sustainable practices. Clearly, in the context of ELV policies, a careful balance must be struck between environmental preservation and economic considerations to garner broader social acceptance.

Our research consistently emphasized prioritizing public health and safety in ELV policies. Participants strongly agreed that ELV policies should prioritize public health and safety, aligning with the findings of dos Santos Soares et al. [64]. These studies underscored the role of safety and health considerations in gaining public trust and acceptance.

The integration of these findings suggests that ELV policies in developed countries should prioritize not only environmental and economic aspects but also emphasize robust safety measures and public health benefits. This comprehensive approach can enhance public support and acceptance.

Our research also highlighted the critical role of awareness in shaping social acceptance. Participants' lack of awareness regarding ELV policies, particularly their environmental impact and technological advancements, underscored the importance of effective communication strategies. This aligns with the findings of Yu et al. [40] and He et al. [43], which emphasized the need for transparent and accessible

communication of sustainability policies to the public.

In critically examining our study's findings in the context of existing literature, notable discrepancies and unexpected outcomes have emerged, offering new insights for policy and practice. While our results reinforce the established notion that enhanced knowledge correlates with increased acceptance of ELV policies, we observed a significant emphasis on the economic and health benefits over environmental concerns. This emphasis diverges from traditional literature that predominantly highlights environmental awareness, suggesting a shift in public priorities or a potential gap in the current discourse. An unexpected yet pivotal aspect revealed in our study is the paramount influence of safety concerns on public acceptance. This prominence of safety, compared to the traditional environmental focus, urges a reconsideration of policy communication strategies.

In light of these findings, we propose specific actions for stakeholders. Policymakers and environmental agencies should adapt their communication strategies to highlight the environmental, economic, health, and safety benefits of ELV policies. This comprehensive approach could lead to broader public acceptance and engagement. Additionally, educational programs must be tailored to disseminate detailed knowledge on these varied benefits, aligning public perception with policy objectives. Furthermore, formulating future policies should integrate these diverse public concerns, ensuring a more holistic and practical approach to ELV management.

The insights gleaned from our research have significant policy implications. Policymakers and stakeholders should focus on educational efforts and awareness campaigns to enhance knowledge levels across various dimensions of ELV policies. Emphasizing the economic benefits of responsible ELV management while ensuring robust safety measures and public health considerations can foster greater social acceptance.

6. CONCLUSIONS

This study delved into the complex interplay between knowledge and the social acceptance of ELV policies in developed nations. The findings highlighted the pivotal role of knowledge in influencing public attitudes towards ELV policies. Well-informed citizens are more supportive, recognizing the policies' importance in environmental conservation, economic growth, public health, and safety.

6.1 Implications of the study

The implications of our research are significant across various domains. Firstly, policymakers should prioritize educational efforts and awareness campaigns to bolster public knowledge, particularly regarding the environmental and technological aspects of ELV policies. This can foster greater social acceptance and alignment with sustainable practices. Secondly, striking a balance between economic considerations and environmental preservation is essential. Policymakers should emphasize the potential economic benefits of responsible ELV management while ensuring robust safety measures and public health considerations. Thirdly, effective and transparent communication of ELV policies is critical. Policymakers and stakeholders should communicate policy details clearly and accessibly, aligning with the findings on the importance of awareness in shaping public acceptance. Lastly,

for future research, exploring the dynamics of knowledge and acceptance in evolving ELV policies, conducting longitudinal studies, and comparing policy acceptance across different developed countries can offer valuable insights.

6.2 Limitations of the study

Despite its contributions, this research is not without limitations. The sample size, while substantial, may not fully represent the diversity within developed nations. Self-reporting bias may have affected the results, especially in the quantitative phase. The findings may not be directly transferable to developing nations with different socio-economic contexts.

6.3 Suggestions for future research

To build upon this work, future research endeavors could investigate the impact of knowledge on policy compliance and behavioral change related to ELV policies. They could also delve into the role of cultural and social factors in shaping ELV policy acceptance across different regions. Moreover, examining the effectiveness of various communication strategies in enhancing public knowledge and policy acceptance and studying the long-term effects of ELV policies on environmental sustainability and economic outcomes could provide further insights.

Last, this study contributes to understanding the intricate relationship between knowledge and social acceptance of ELV policies in developed countries. By addressing the implications and limitations while providing suggestions for future research, we aim to inspire further inquiry into this vital area of sustainable policy development and implementation.

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