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Case vignettes-based workshops as a tool to facilitate interdisciplinary engagement with complex problems in sustainability education

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Abstract
Antimicrobial resistance (AMR) is an emerging challenge for sustainability education. This study examines how case vignettes as a tool, when integrated within participatory workshops, foster interdisciplinary collaboration and participatory research, focusing on their application to the complex challenge of AMR. Two one-day participatory research workshops were conducted at higher educational institutions, involving a total of 60 interdisciplinary participants, including 10 educators and 20 students from two universities in Zimbabwe. A thematic analysis using analytical categories based on previous literature resulted in the development of six themes, ranging from developing systems thinking, and thorough decision justification, to co-created knowledge. These themes highlight the potential of case vignette-based workshops to support collaborative problem-solving and knowledge exchange in addressing complex societal challenges like AMR. Such as interdisciplinary engagements, effectively highlighting the complex and "wicked" character of AMR that spans domains of knowledge, ethics, policy, and practical intervention to which each discipline can contribute through the use of integrated case vignettes.

Keywords Case vignette tool, Higher education, Sustainability education, Global health, Wicked problems

1 Introduction

Antimicrobial resistance (AMR) is a major health threat and every year, about 1.3 million people die from infections caused by antimicrobial-resistant bacteria. This figure is predicted to increase to 10 million by 2050 [19, 30]. AMR affects countries in all regions and at all income levels; however, it disproportionately affects Southern Africa, adding pressure on systems of health care and food security [12, 13, 42]. AMR can thus be understood as a wicked problem, meaning that it is complex and systemic, lacking clear boundaries and having multiple actors with competing interests [8, 21, 25], 39].

This makes wicked problems difficult to solve through the use of any single disciplinary knowledge as interventions in one area such as agriculture may have unintended impacts in for example health care or food safety [16, 17, 40]. As such, AMR requires sector-specific actions and effective collaborations in food production, human health, animal and environmental sectors, where a One Health approach to preventing AMR is often stressed. One Health refers to a unifying holistic approach that aims to achieve sustainable health outcomes for people, animals and ecosystems [52]. According to WHO [51], implementing more awareness through communication and educational institutions is one way to combat AMR and further encourage holistic interdisciplinary action. Through participatory workshops involving students and educators from diverse disciplines, we explore how vignettes facilitate systems thinking, ethical reasoning, and co-created knowledge across boundaries (e.g., medicine, agriculture, environmental science).

This paper uses participatory research workshops as a method to explore how case vignettes can be used as a structured and contextually relevant tool for facilitating interdisciplinary collaboration. We study how case vignettes when integrated into participatory workshops enable collaborative engagement with AMR as a wicked problem. The workshops involve students and educators from diverse disciplines, and the paper explores how case vignettes facilitate systems thinking, ethical reasoning, and co-created knowledge across disciplinary boundaries (e.g., medicine, agriculture, environmental science). This builds on previous research, which positions participatory research workshops as a method for interdisciplinary collaboration [3, 34] and case vignettes as tools for learning based on real-life scenarios [14, 43]. From this research that focuses on integrated educational approaches to address complex sustainability challenges we operationalise systems thinking, ethical reasoning, and interdisciplinary engagement as three analytical categories to that reflect key competencies for navigating complexity. By drawing on these analytical categories grounded in previous research we can explore how case vignettes as a tool can be operationalized as part of participatory research workshops to facilitate the development of these competencies across disciplinary boundaries. The paper thus studies the potential of case vignette-based workshops, in which vignettes are used in facilitated discussions as part of two participatory research workshops on AMR involving students and lecturers from higher educational institutions (HEI). The paper seeks to make a methodological contribution in terms of developing an integrated use of case vignettes as part of participatory research workshops in education. Furthermore, the paper intends to make an empirical contribution by operationalising the case vignette tool as an integrated part of participatory research workshops through an empirical example of sustainability education addressing AMR. While the paper explores the use of case vignettes in the context of AMR, the methodological contribution of participatory workshops using case vignettes as an integrated component can be applied to other complex sustainability challenges.

As a method in research, case vignettes are according to Finch [14] as well as others [31, 43, 47] effective in enabling diverse groups of participants to engage with problems that are characterised by complexity and unpredictability [40]. Since case vignettes are short representations of real-world situations, they become a useful platform for interdisciplinary analysis where participants from different areas of research, such as medicine, veterinary sciences, agriculture and education, come together to unpack and

discuss the dimensions of these problems [16]. The key for such case vignettes is capturing how practices can have varied and unpredictable impacts beyond the immediate situation often crossing the boundaries between, for example, human and animal health [48]. Case vignettes can thus facilitate systems thinking on the part of participants, reflecting on how their specific disciplinary knowledge contributes to understanding and potentially addressing AMR [9]. By stimulating such interdisciplinary discussions and analysis, case vignettes are well placed to enable insight self-reflection on the part of the participants into different ways to know the challenge, ethical reasoning around the problem, as well as interdisciplinary collaboration in navigating priorities and making decisions to address the AMR.

As such, the strength of case vignettes in line with Barter & Renold [2] lies in creating clearly framed conditions under which participants from diverse disciplines can engage and explore AMR as a challenge not only for human health but also closely interconnected to the health of animals and the environment. Spaces are thus created for participants to draw on diverse conceptual knowledge and understandings of AMR in addressing a specific practical situation. Carlile [4], Palczewska & Pilarski [36] and Payton & Gould [38] describe this as an opportunity for boundary-crossing between disciplines, resulting in participants co-creating holistic ways of addressing AMR that integrate diverse knowledges. Through such knowledge co-creation, novel ways can emerge to address challenges outside the purview of any individual discipline [22–24]. Case vignettes can thus facilitate the bridging of the gap both between disciplines and between knowing and doing in terms of drawing on interdisciplinary ways of knowing to address AMR in practice [14, 31, 43, 47]. To this end, case vignettes as framed but open-ended descriptions of wicked problems have productively been operationalised as part of research that engages with whole-society sustainability challenges that necessitate holistic approaches and interdisciplinary collaborations [43, 47]. Furthermore, case vignettes stimulate ethical reasoning when participants are faced with ethical quandaries such as the long-term impact in terms of resistance from the use of antimicrobials for individuals, short-term food security and economic stability [35]. As participants discuss their reasoning for suggesting a course of action, they are given the opportunity to reflect on how they value and prioritise different courses of action and interests regarding AMR and how differences in the ways of knowing the challenge affect these value judgements [18].

These reflections also extend to critically engaging with policy, including challenges to policy adaptation and implementation, understanding the opportunities and limitations of regulation, community involvement and engagement as well as how governance can be used in conjunction with communities to address AMR. As such Murphy et al. [31] highlight how case vignettes can highlight competing interests and the need for discussions of trade-offs.

The paper makes methodological and empirical contributions by integrating case vignettes into participatory research workshops focused on AMR as a wicked problem. By drawing on participatory research principles [3] and existing case vignette research [14, 43]. A structured two-step process is developed where participants partake in conceptual reasoning and reflection on two case vignettes to bring up and contrast diverse disciplinary perspectives, followed by ethical reasoning to explore trade-offs and responsibilities in AMR. Participants are then facilitated in interdisciplinary engagements as

they explore opportunities for collaboration. Supported by our three analytical categories, the analysis provides insights on how students and educators, within an educational setting can be engaged with sustainability and health challenges and develop relevant competencies to address these challenges. In framing AMR as a wicked problem, the paper moves beyond the single-discipline use of case vignettes, operationalising them as tools for systemic analysis and practice-based engagement, enabling participants to engage with situated ethical challenges between food security, economic pressures, and public health and how trade-offs can drive resistance. The approach presented in this paper highlights how participatory, vignette-based, workshops can act as boundary-crossing between disciplines, making it replicable in engaging diverse actors with wicked problems such as AMR.

2 Methods and materials

The study operationalised participatory research workshops as its principal method and used case vignettes as the tool to structure the discussions and promote interdisciplinary collaboration within the workshops. Workshops utilised the principles of participatory workshops outlined by [3, 34, 44], with an emphasis on case vignettes to enable knowledge co-creation across disciplinary boundaries [4], were conducted each structured around two case vignettes, as a tool to provide real-world scenarios for interdisciplinary engagement and collaboration. This aligns with operationalising workshops as spaces for addressing wicked problems [17] and using case vignettes as tools to engage with interdisciplinary tensions and build collaborations beyond disciplinary boundaries [41].

2.1 Case vignettes

In constructing the case vignettes (see appendix 1), we focused on choosing relevant facts and information including a combination of knowledge and insights drawn from research regarding antimicrobial use and AMR in Zimbabwe [5, 6, 10, 15, 19, 28, 29, 45, 46], as well as experiences and practices around antimicrobial use and the emergence of resistance in the Zimbabwean context. Initial vignette drafts were constructed and shared with research colleagues from different disciplines with knowledge and experience of AMR in Zimbabwe, for linguistic accessibility and comprehension. By thus drawing on the interdisciplinary experiences from AMR and the use of antimicrobial research and practice, the case vignettes were improved for further contextual relevance and linguistic clarity to the Zimbabwean sustainability challenges in general and AMR challenges in particular.

The case vignettes focused on the impacts on health and food security from the usage of antibiotics (AB) and antiretrovirals (ARV) in beef cattle and poultry raising (see Appendix 1). As such, the two case vignettes addressed different aspects of the intersections between health, food and AMR, focusing on the use of antibiotics and antiretroviral drugs respectively by small-scale farmers in the line of food production and their impact on the health of humans, animals and ecosystems. The first vignette is reflective of how the majority of antibiotics are used in Southern Africa as part of cattle and poultry production, and how farmers often include them in the feed of healthy animals proactively to prevent potential infection. In the second vignette, we follow the outcomes of what has been documented in research and government reporting, as farmers in Zimbabwe, put under severe economic pressure, re-distribute to farm animals antiretroviral

drugs given to themselves or members of their community to treat HIV/AIDS infections to increase growth in the animals.

2.2 Participatory research workshops

Two one-day participatory research workshops were held at the Midlands State University, Gweru, and the University of Zimbabwe, Harare. The study included 60 interdisciplinary participants, 10 educators and 20 students sampled from each university. They were recruited based on their experiential encounters from being part of physical, social and institutional environments across such diverse fields as medicine, pharmacy, veterinary science, education, agriculture, and environmental science. The selection of participants was based on a holistic understanding of health and sustainability, encompassing participants from a range of departments and academic disciplines all sharing an interest in the intersections of health, food, food security, sustainability and antimicrobial resistance.

Through the case vignettes, the workshops explored the relational processes of creating knowledge regarding the implementation of global and national policies on health, food, sustainability and AMR. This extended to engaging with the intersection of health, food and AMR as wicked sustainability challenges and how they emerge in the local situations and contextual practices of Zimbabwean rural and urban health education. To this end the workshops aimed at enabling participants to envision sustainable, healthy futures in line with global and national policy [7, 20, 38, 41, 49]. Key in choosing to operationalise case vignettes is their potential through narratives to explore participants' conceptual and ethical reasoning around different aspects of AMR, promoting interdisciplinary engagements.

2.3 Conducting the participatory research workshops

The workshops were organised through the case vignettes, outlined in Fig. 1, in the form of written stories that the participants listened to, while the text was displayed on a screen. The workshops were co-facilitated by the authors along with note-taking from colleagues at respective universities. Workshops were audio recorded and transcribed by

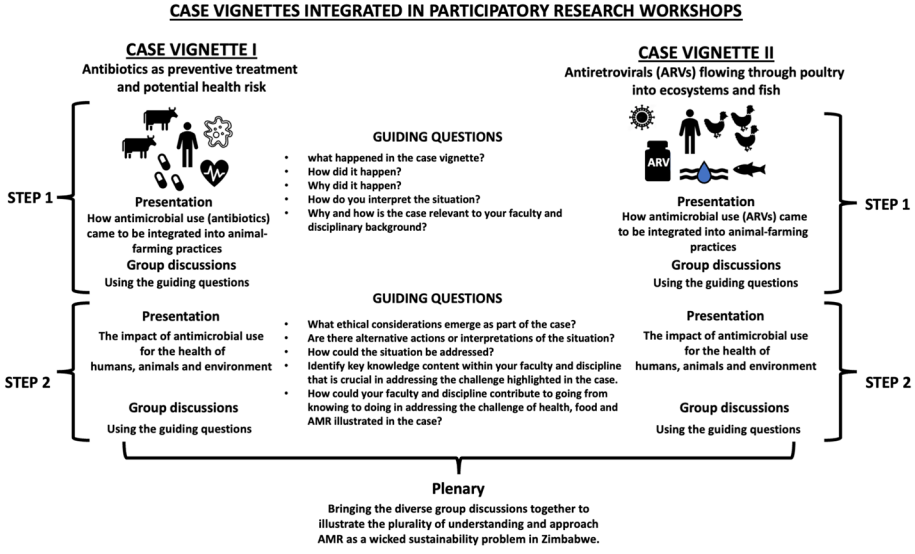

Fig. 1 Case vignettes integrated in participatory research workshops

the authors with support from contemporary notes for improved depth and accuracy in the transcripts.

The workshops were designed with three objectives in mind: to enable participatory and interdisciplinary knowledge co-creation, to leverage case vignettes as boundary objects [4] to bridge gaps between participants´ disciplines and expertise, and to encourage systems thinking among participants through iterative analysis. To this end, the workshops followed a structured protocol of first introducing an overview of AMR as a wicked problem and the objectives of the vignettes. This was followed by a first discussion where participants in small groups analysed vignettes using guiding questions (see Appendix 1).

During a second discussion, participants in the same groups, revisited the vignettes using ethical/policy questions, including ethical considerations, responsibility, trade-offs and opportunities for systemic actions to identify interdependencies enacted in the vignettes. Concluding the workshops, a plenary synthesis facilitated joint mapping with the participants of AMR drivers and solutions, emphasising interdisciplinary synergy. The protocol aligns with participatory research frameworks [3] and mirrors iterative, systems-oriented approaches to wicked problems [17].

Furthermore, the case vignettes were outlined as examples of antimicrobial use among small-scale farmers where participants would discuss how they understood the situations detailed based on their disciplinary knowledge and expertise, especially with regard to impacts on human, animal and environmental health.

Concluding the workshop, a joint plenary was held during which the two case vignettes were discussed with groups sharing their reflections and how they approached the challenge presented in the vignettes. The key for these plenary discussions was the highlighting of the plurality of understandings and approaches developed by the participants based on their ways of grasping and addressing the challenges relating to antimicrobial use, AMR as well as the health of humans, animals and environments. To this end, the plenary contributed to the outcomes of the workshops by bringing the diversity of the group discussions together, highlighting how the plurality of understandings and approaches around AMR as a wicked sustainability problem in Zimbabwe can be held.

The vignettes allowed participants to contribute with their unique perspectives as well as being mindful of including complexity and individual motivations to avoid framing the small-scale farmers as the sources of problems regarding AMR. As participants engaged with the case vignettes in the participatory workshops, discussions took the form of third-person statements. Meanwhile, participants positioned themselves as health practitioners with a role to communicate and educate around AMR in sustainability education within the HEI and beyond throughout society. While engaging with vignettes, participants were asked to adopt analytical roles as'disciplinary experts'. For example, medical professionals analysing antibiotic resistance risks or agricultural lecturers assessing farming viability. The participatory research workshop method provided structure for the data collection and created conditions for knowledge co-creation on the relationship between health literacy and AMR.

2.4 Data analysis

The paper utilised a deductive top-down approach in analysing the transcript data from the workshop discussions. A theory-driven approach, our use of deductive qualitative

Table 1 Description of the steps of the analysis

Step number	Description of the steps of the analysis
Step 1	We read through the transcribed materials from the workshop discussion multiple times, focusing on poignant statements and interesting ideas expressed by the students
Step 2	In the transcribed Word documents, we identified recurring ideas of interest using systematic colour codes
Step 3	Reviewing the colour-coded documents, we compiled similar quotes from the discussions and used a theory-informed approach based on how conceptual reasoning, ethical reasoning and interdisciplinary engagements as analytical categories are expressed in participants' discussions on the case vignettes. Using comparative readings, we considered the categorisation of quotes into the analytical categories
Step 4	9 themes of the workshop discussions were developed from the analysis of the discussion quotes: (1) Disciplinary framing, (2) identifying knowledge gaps and (3) developing systems thinking as part of conceptual reasoning; (4) value conflicts, (5) distributing responsibility and (6) decision justification as part of ethical reasoning; (7) boundary-crossing, (8) conflict resolution and (9) co-created knowledge as part of interdisciplinary engagements
Step 5	As part of this step, themes were re-checked against the empirical materials to make certain that no important aspects of the workshop discussions were unaccounted for in the themes
Step 6	To provide readers with convincing arguments for our analysis, illustrative examples were selected out of the coded empirical materials. These were aimed at justifying the themes and supporting our analytical results and conclusions. Throughout this final step, the paper´s aim and research questions guided the analysis and writing of the analytical report

content analysis drew on a pre-existing analytical framework that we applied systematically to the transcript data, enabling us to explore our analytical categories [11, 26]. In studying the workshop transcripts, the analysis operationalised three analytical categories based on previous literature [14, 38, 41, 43, 50], (i) Conceptual reasoning. (ii) ethical reasoning, (iii) interdisciplinary engagements. These categories were used to guide the analysis when developing themes from recurring topics of discussion in the workshop transcripts. This provided a structured lens through which to examine how workshop participants expressed aspects of these analytical categories when discussing the case vignettes dealing with AMR challenges. This top-down approach ensured that the analysis remained focused on understanding how case vignettes enable collaborative problem-solving and knowledge exchange among workshop participants in addressing complex societal challenges like AMR. The deductive analysis utilised six (6) subsequent steps as outlined in Table 1 below.

2.5 Ethical considerations

Ethical approval for the project was received from the Medical Research Council of Zimbabwe (MRCZ/A/2920). As part of planning the study, permission was sought to conduct workshops with sustainability education practitioners and students at respective universities. The study adhered to the principles of informed consent and voluntary participation. Participants were provided consent forms and information sheets detailing the research aims, the workshop process, as well as the collection and management of research data. Opportunities were provided for participants to raise any questions regarding the research and workshop before going through and signing the consent form, with further opportunities offered during the workshops. The global code of conduct for research in resource-poor settings (TRUST 2018) was adhered to in the study. Participant codes were used, and no participant names were recorded as part of the data collection.

3 Results

In exploring the role of case vignettes as a method for participatory research workshops, it became clear that it facilitated interdisciplinary engagements, effectively highlighting the complex character of AMR as a "wicked problem" that spans across domains of knowledge, ethics, policy, and practical intervention to which each discipline can contribute. Crucially, the case vignettes were able to capture the realistic and complex situations of wicked problems such as AMR.

3.1 Conceptual reasoning

The case vignette-based workshops promoted conceptual reasoning about AMR as participants from diverse university disciplines, including medicine, agriculture, food and nutrition, veterinary science, and education, explored AMR using the vignettes as part of three interlinked themes, disciplinary framing, identifying knowledge gaps and developing systems thinking.

The theme disciplinary framing highlights how participants interpreted the case vignettes from the perspective of their respective disciplinary knowledge and expertise. Each discipline outlined different dimensions of the AMR challenge. While participants from medicine focused on clinical misuse of antimicrobials and agricultural participants emphasised productivity and food security, veterinary science and food science participants highlighted animal health, the use of antimicrobials in animals and food safety concerns. The vignettes thus created spaces for disciplinary ways of knowing AMR to intersect, as illustrated by the following quote,

> *I have noted that there is misuse of the antiretroviral drug... but instead of taking that drug, the drug is also being taken to feed the chickens that are going to be consumed by the humans.*

Through the discussions, disciplinary framing thus enabled the participants to unpack the complex dimensions of AMR.

The theme, identifying knowledge gaps, illustrates how the participants' discussions of the case vignettes enabled them to reflect on the limitations of their disciplinary knowledge in addressing AMR. Participants discussed AMR as cutting across areas of practice, including health care, agriculture, and the environment, with them realising how their specific disciplinary expertise was not able to address the diverse dimensions of AMR. As such, participants from agricultural sciences emphasised the impact of ARV misuse on agricultural productivity and food security, which differed from how medical and food sciences participants focused more on how the misuse might result in less effective use of ARVs moving forward. While this created gaps and tensions between the disciplines, they both acknowledged how they needed both knowledges in addressing AMR. These tensions were productive in that participants' acknowledgement of the disciplinary gaps allowed for learning and collaboration, which supported greater openness and consideration of other disciplinary perspectives. In turn, this led to a recognition of the need for knowledge integration around AMR as seen in the following quotes.

> *So I think one of the measures that we need to put in is that these different disciplines, health, food, this agriculture should work hand in hand. Different disciplines should work hand in hand, give each other knowledge and pass on knowledge.*

So, maybe we can come up with an interdisciplinary project to tackle some of these issues.

The case vignettes thus enabled participants to acknowledge how none of their disciplines could fully account for the complexity of AMR nor present a comprehensive solution of how to address the wicked problem.

The theme of systems thinking includes how participants became aware of the links across disciplinary boundaries. Through the case vignettes, participants developed, as seen in the following quote, insights regarding the systemic interconnectedness of wicked problems as the spread of AMR from farm animals, through ecosystems to humans, crosses many disciplinary areas.

The farmer doesn't know the effects of continuing to consume that chicken...the effects might be seen in the tilapia.

Participants came to conceptualise AMR through a holistic system understanding where decisions in one area, such as giving farming animals antimicrobials, could impact other systems, including ecosystems and health care. Participants thus moved beyond disciplinary silos, seeing AMR not as a collection of isolated issues but as a complex, dynamic system requiring coordinated action. Responding to the challenge posed by the case vignettes, participants articulated holistic conceptualisations of AMR that included waste management, farming practices, and food production systems.

3.2 Ethical reasoning

The case vignettes also prompted ethical reasoning regarding AMR. Participants discussed ethical challenges resulting from antimicrobial misuse in farming and agriculture, and its impact on human health, ecosystems, food security and health systems. Three themes were developed from the analysis of the participants' discussions that were understood as ethical reasoning: value conflicts**,** distributing responsibility**,** and decision justification**.**

The theme “value conflicts” highlights how participants discussed tensions between individual economic incentives and collective health and environmental well-being. The case vignette's narrative of antimicrobial misuse by a farmer to increase the growth of his chicken for economic gain while driving resistance had the participants critically reflecting across disciplines on multiple emerging tensions. From the agricultural science perspective, there were concerns raised about antimicrobial-contaminated manure seeping into ecosystems, while food science participants highlighted how unregulated antimicrobial use could risk the safety of the food chain, as highlighted in the following quote.

Ethically, what the farmer is doing is not correct because the end consumer of the chicken doesn't know the treatment that the chicken has gone through.

Short-term economic gain and long-term ecosystem and health risks were recognised to be typical of AMR as a wicked problem. Through the vignettes, participants could thus appreciate the tensions emerging between the interconnected systems of economy, environment, and social cohesion around AMR, as illustrated by the following quotes.

> *I feel he was being ethical in terms of himself. Remember, we are in a Zimbabwean society with the economy like this. So, to a certain extent, he had to somehow think of himself as Zimbabwean. To a certain extent, I will not refuse that he somehow affected a larger area. Let's all consider it in a personal level. What would you do, given that advice? So, the unethical people are the ones who would feed their ARVs. Okay, so you're defining us as self-centered survivors of this economy.*
> *Even considering the current situation of Zimbabwe. But you can't save your own self risking the lives of others.*

The theme of distributing responsibility shows how the case vignettes prompted participants to explore who should be held responsible for the consequences of antimicrobial misuse. While the ethical responsibility of farmers was highlighted, participants also acknowledged how responsibility needed to be allotted to government actors, such as agricultural extension officers and regulators, who should educate and support farmers in how to use antimicrobials responsibly. Furthermore, there was a shift in the participants´ discussion from seeing the individual as the problem to a more systemic critique where responsibility fell on regulatory bodies, agricultural services, and food safety systems to monitor and manage responsible antimicrobial use, as exemplified in the following quote,

> *Because I think farmers have an ethical obligation to provide safe meals, to provide safe food, and also to provide food that is not harmful to the human population. But I don't think this was considered, partly because I think there's a disconnection amongst the various sectors, such as the Veterinary Services Department, Agricultural Extension, Water Science, and also, I'm just wondering, where was he getting these antibiotics? Are they just sold over the counter? Because there should be some regulation, of some sort, so there is no regulatory framework, in terms of accessibility, of these antibiotics.*

Participants thus acknowledged how ethically problematic practices often result from a lack of support from government and society at large, and that responsibility should thus not be solely distributed to individuals lacking both resources and support to be more responsible in their practices. The case vignettes thus encouraged participants to think beyond individual practitioners, such as farmers and engage with collective and institutional responsibilities in addressing wicked sustainability challenges such as AMR.

Furthermore, case vignettes prompted participants to make sense of the farmers´ decisions, which involved critically considering how antimicrobial practices emerged in complex situations of economic, social and institutional pressures. Reflecting on the motivations for antimicrobial use in chickens and other livestock, including protecting food security and providing economic benefit, meant that participants had to weigh immediate benefits against more long-term and often unintended consequences, such as resistance spread and environmental contamination. As seen in the following quotes, participants often found a degree of justification for the farmers' decisions.

> *Chicken farming is not an easy job. So to some extent, well, his actions are not justified, but then to some extent, he was now making a living and his life improved.*
> *He was focusing on profit, but he was obsessed with making profit forgetting about this ARVs and their implications. On my take on the case, number two, it was like*

a fatherhood, a parental thing, out of him. It was all about the parenthood. [...] It was fatherhood which affected him a lot. He wasn't self-centred. So, he forgot about himself too.
Okay. I think he probably wasn't a bad man at all.

These justifications highlighted how participants' ethical reasoning around farmers´ decision-making on the use of antimicrobials in agricultural practice came to be reflective and systems-oriented. Together, they grappled with the ethical aspects of AMR as more than a medical issue but as a challenge interconnected with agriculture, ecosystems, economics, and policy, where governance, regulation and community emerged as key in upholding ethical standards of behaviour and responsibility around antimicrobial use and its impacts on the health of all.

3.3 Interdisciplinary engagements

Through the case vignette-based workshops, participants were provided a space for interdisciplinary engagements as they collaboratively sought to address the challenge of antimicrobial misuse, drawing on their respective knowledge and expertise from agriculture, food science, public health, and environmental studies. Three themes were developed from the analysis of participants´ discussions as constituting interdisciplinary engagements: boundary-crossing, conflict resolution, and co-created knowledge.

The theme of boundary-crossing illustrates how case vignettes enabled participants to collaborate across disciplines to create a more nuanced understanding of the challenges and to address the complexity of AMR. This included discussing how agricultural practices and food safety were linked through AMR, necessitating cooperation. For instance, participants suggested methods such as testing chicken meat and wastewater for ARV residues before allowing them into food and water systems. This approach promoted joint problem-solving by integrating food science, public health, and environmental management into discussions about controlling AMR. This further emphasises the close relationship between policy, governance and practice in developing interdisciplinary and collaborative solutions for wicked problems. The participants highlight the need for transdisciplinary approaches and boundary-crossing in connection with educational needs as seen in the following quote.

So I think one of the measures that we need to put in is that these different disciplines, health, food, this agriculture should work hand in hand. Different disciplines should work hand in hand, give each other knowledge and pass on knowledge.

Participants stressed how breaking siloed institutional structures, there were opportunities to pass on new knowledge, exchange experiences and co-create new knowledge.

Acknowledging gaps in disciplinary knowledge and practice such as between veterinary services and agricultural extension, the case vignettes enabled participants to identify barriers and opportunities for boundary-crossing initiatives to address AMR.

Furthermore, the participant mentioned:

I think there is a knowledge vacuum, in terms of what are the implications, regarding the various practices that are involved in livestock production. [...] there's a disconnection, amongst the various sectors, such as the Veterinary Services Department and Agricultural Extension.

Highlighted in this quote is how the case vignette stimulated participants to identify the dimensions between silos, and the need to cut across sectors in order to combat knowledge vacuums and to co-create new innovative ways of conflict resolution. Furthermore, highlighted by the participants' discussions based on the case vignettes are how individual stakeholders´ practices are occurring within contexts characterised by socio-economic and policy dynamics as well as ongoing concerns for food security. A key aspect noted by participants was how problematic antimicrobial practices were perpetuated by poor guidance, support and regulation of agricultural practices and the use of antimicrobials. As such, the case vignette discussions prompted participants to call for more comprehensive and consistent policy implementation, especially in relation to the food chain, as seen in the following quote:

> *We have to have mechanisms of measure...we cannot just identify that this person is using ARVs just based on general things*

To this end, there is a need to further understand how and why antimicrobials are misused as part of policy and regulation, preferably informed by interdisciplinary knowledge. As such, opportunities were raised regarding rethinking agricultural and food systems that better align with environmental sustainability and public health goals. Together, the three major themes of conceptual reasoning, ethical reflection and interdisciplinary engagement together illustrate how case vignettes can be operationalised as tools in enabling participants to navigate and respond to complex problems like AMR. Through the structured and open-ended character of the vignettes, participants explored the multifaceted aspects of AMR while simultaneously identifying approaches for interdisciplinary integration, thus highlighting the methods´ potential in addressing sustainability challenges in diverse contexts. The workshop discussions highlight how finding approaches to AMR necessitates crossing disciplinary boundaries, resolving tensions between stakeholders, and creating shared understandings and solutions, which the case vignettes were key in promoting.

4 Discussion

The results outline how the case vignette-based workshops created had multiple functions, including highlighting conflicting values and perspectives around AMR as a wicked problem, while at the same time showing how efforts to address this challenge require interdisciplinary collaboration, as any solution needs to build on systemic engagement and transformation. Crucially, the case vignettes enabled the participants to draw on their expertise and reflect on the sustainability challenge beyond their respective disciplinary boundaries to engage each other and share knowledge in ways to consider holistic approaches to AMR and lay the groundwork for subsequent co-development of sustainable solutions to this wicked problem. According to WHO [51], one way to address the challenge of AMR is to improve awareness and understanding of antimicrobial resistance through effective communication, education, and training. The results showed how case vignettes operationalised WHO´s recommendations by developing awareness in higher education through a process that included communication as part of conceptual reasoning, ethical reflection and interdisciplinary engagement. Enabling participants to engage in interdisciplinary discussions, the method facilitated the identification and internalisation of complex AMR scenarios. These discussions

moved beyond knowledge disseminations to knowledge co-creation. We stress that the results of this study show that vignettes as a tool are a possible way forward in order to coordinate a holistic response to AMR.

The case vignette tool as an integrated part of the participatory workshops contributed to focusing on the interdisciplinary space and engaging participants in shared matters of concern to which they could contribute with their respective disciplinary expertise and share knowledge with the aim of collaboratively exploring AMR as a complex sustainability challenge. The complexity presented through the case vignettes required participants to engage with questions that went beyond their specific disciplinary expertise, including ethical and systemic policy and governance issues, which are all part of wicked problems. To this end, case vignettes provided further depth to the interdisciplinary engagements around wicked problems by facilitating joint reflection regarding individual and collective responsibilities, ethical considerations, and the necessity for comprehensive efforts in addressing AMR. There was thus a shift as part of the discussions with participants considering not only the symptoms of the wicked problem but the drivers of AMR as a result of the pressures and incentives of antimicrobial use in farming.

To this end, the paper showcases how the integration of case vignettes in participatory research workshops represents an innovative approach to enabling interdisciplinary collaboration in navigating priorities and making decisions in education. The workshops present an open-endedness to the method where participants can all contribute with their interdisciplinary expertise and experiences. Meanwhile, the integrated case vignettes provide content, focusing on the proposed method in addressing a certain topic. This combination thus creates an attentive open-endedness in terms of educational research methods. Crucially, this offers a space that is well adapted to collaboratively exploring and engaging with ethical questions and topics.

In line with Sheringham et al. [41], the results highlight how case vignettes present realistic situations with which participants can explore the complexity of wicked problems, especially related to questions of uncertainty, ambiguity, and systemic interconnectedness. This was exemplified as part of the workshop discussions on how initially agricultural and animal farming practices came to spill over and become issues for the ecosystem and public health as well as food safety.

Crucially, the results highlight how case vignettes as a method in workshops create what [16, 17] notes how short cases, "vignettes" create scenarios for participants of closely interwoven systems of social, health, economic, and environmental conditions. As such, vignettes support workshop participants in engaging with broader systems within which wicked problems emerge and evolve. This aligns with using case vignettes as tools to engage with interdisciplinary tensions and build collaborations beyond disciplinary boundaries. As Sheringham et al. [41] highlighted in their use of climate-risk vignettes to enable interdisciplinary engagement, our study illustrates similar impacts, while adding a further focus on ethical complexity and contextual relevance. This was done through the development of the vignettes and the incremental introduction of the case, with participants first discussing the immediate situation and in a second step being presented with further ethical dilemmas.

Furthermore, the results of our study illustrate more equal engagements between disciplines including medicine, agriculture, food sciences, and education resonates with how case vignettes have been argued to promote a move to democratise expert knowledge

in which interdisciplinary collaborations are at the forefront and deference is not given to single disciplines to provide solutions to wicked problems. In relation to Parthasarathy et al.'s [37] results exemplifying university-NGO partnerships as pathways for social innovation, the paper's results indicate that workshops operationalising case-vignettes can create spaces for interdisciplinary innovations in sustainability education and practice. Opportunities for collaborative knowledge co-creation around shared concerns notwithstanding differences in approaches to knowledge are offered through vignettes. As seen in the results, participants used the vignettes to grapple with diverse aspects of the wicked problem and how these were interconnected, allowing them to navigate the tension between the need for food security and public health as part of addressing AMR.

Moreover, vignettes, as highlighted in the results, enable participants to engage in situated ethics where questions of responsibility and decision making are localised within a specific situation while being contextualised as part of broader socio-economic-ecological systems. As such, the vignettes created spaces for participants to discuss individual and collective responsibilities and how to navigate the recurring ethical grey areas typical of wicked problems [33]. In line with Veltman et al. [50], the results highlight how operationalising case vignettes provided an adaptive framework in which workshop participants could collaborate and engage together with the conceptual, ethical and practical challenges of wicked problems such as AMR. This was exemplified in how the vignettes drove discussions among the participants regarding the need to not only focus on individual responsibility but for more consistent governance efforts around the access and use of antimicrobials, including ARVs to avoid them ending up in livestock and small-scale farming practices coupled with substantive monitoring and quality checking of the quality of the meats produced and offered through the food chain. To this need for more substantial governance, the results highlighted how participants simultaneously identified the necessity for changes in policy implementation, monitoring and regulation and the challenges of practically regulating the usages of antimicrobials throughout the country and food chain. As such, the vignettes allowed participants to join in critical reflections on policy implementation discussions that are key [43, 47].

5 Conclusion

This paper explored how the potential of case vignettes as a research method, highlighted by previous research, was realised in participatory workshops engaging with antimicrobial resistance as a One Health challenge. The study´s limitations included a non-exhaustive and context-specific selection of disciplines that may not account for the full spectrum of perspectives and approaches relevant to addressing a complex sustainability problem such as AMR. Meanwhile, the results indicate the potential in interdisciplinary engagements through case vignette-based workshops. Moreover, while the vignettes were developed based on documented research and practices as well as being tested for contextual relevance, they remain hypothetical scenarios. As such, their relevance and effectiveness as tools for sustainability education rely on participants´ ability to suspend disbelief and thoroughly engage with the vignettes as realistic narratives of AMR as a complex sustainability problem.

Case vignette-based workshops, in which vignettes are into participatory research workshops were shown to create value in terms of engaging with AMR as a wicked problem characterised by complexity and unpredictability, requiring interdisciplinary

engagements. The themes identified in the results section align with what has been emphasised in previous research, while contributing with in-depth knowledge of how case vignettes enable workshop participants across disciplines to move beyond their respective disciplinary boundaries to explore both conflict and complementarity in terms of working together to address AMR. Crucially, the paper shows how case vignettes create spaces for collaboration around the shared challenge of AMR, including developing systems thinking, knowledge integration, ethical reflection and joint problem solving. The paper makes a methodological contribution in terms of developing an integrated use of case vignettes as part of participatory research workshops in sustainability education. Furthermore, the paper makes an empirical contribution by operationalising the case vignette tool as an integrated part of participatory workshops through an empirical example of sustainability education addressing AMR.

Based on the paper´s results, we recommend the use of case-vignette-based workshops with case vignettes as a integrated tool in sustainability education across higher education institutions, especially as part of programs on health, agriculture, veterinary sciences, dietetics, and environmental sciences. Case vignette-based workshops could productively be used, particularly in interdisciplinary modules and projects that encourage students to engage with real-world sustainability challenges by bridging the gap between academic knowing and professional practice. The workshop method and case vignette tool can also be included in professional training programmes as part of broader sustainability education to enable participants to explore and engage in decision making around sustainability challenges as characterised by ethical dilemmas and uncertainty. As such, case vignettes as integrated parts of participatory research workshops are positioned to be key tools for engaging groups from across disciplines in joint knowledge creation and problem-solving to address AMR as a complex challenge that includes the whole of society and cannot be neatly delegated to any single area of research and knowledge.

Appendix 1

Case vignettes and workshop questions

The two case vignettes address different aspects of the intersections between health, food and AMR, focusing on the use of antibiotics and antiretroviral drugs respectively by small-scale farmers in the line of food production and its impact on the health of humans, animals and ecosystems.

The first vignette is reflective of how the majority of antibiotics are used in Southern Africa as part of cattle and poultry production, and how farmers often include them in the feed of healthy animals proactively to prevent potential infection.

In the second we follow the outcomes of what has been documented in research and government reporting, as farmers in Zimbabwe, put under severe economic pressure, re-distribute to farm animals antiretroviral drugs given to themselves or members of their community to treat HIV/AIDS infections with the aim of increasing growth in the animals.

Case vignette 1: Antibiotics as preventive treatment and potential health risk

Thokozani has recently taken over responsibility for the family beef cattle farm from his father and while eager to develop it and grow the herd he is also concerned about the health of the cattle and the risk of disease as the extended family relies on the beef cattle for important dietary protein as well as a source for profit. Within Zimbabwe, there are many endemic infectious diseases that affect cattle, and that could threaten the food security and health of the community.

During the first year of running the farm, there are outbreaks of Black leg in the region, a severe cattle disease cattle caused by the bacteria *Clostridium chauvoei* affecting young and responsible for a significant part of cattle mortalities in Zimbabwe. The majority of antibiotics in Southern Africa are used in cattle and poultry farming often as part of proactive measures. Although vaccines are encouraged by the Department of Veterinary Services (DVS), the use of antibiotics remains the major preventive and control strategy for most bacterial infections in cattle in Zimbabwe. As such, the idea of using antibiotics to prevent potential disease is close for Thokozani. By mixing the antibiotic *penicillin* into the feed of his healthy cattle, he hopes to safeguard the food security and health of his family. It is an initial success, none of his cattle is infected, and the use of antibiotics in the feed increases the growth of the cattle, making the farm more profitable.

Case vignette 1 discussion, round 1

What happened in the case vignette?
How did it happen?
Why did it happen?
How do you interpret the situation?
Why and How is the case relevant to your faculty and disciplinary background?

Case vignette 1 continued

Encouraged, Thokozani continues mixing antibiotics, penicillin and over time other antibiotics, in the cattle feed until he hears about an outbreak of a multi-resistant bacterial infection at the local clinic. The bacteria causing the infection turns out to be resistant to antibiotics available at the clinic and patients have to be sent for intensive care in the regional hospital. The Health Department and the DVS launch investigations to track the origin of the multi-resistant mutation of the bacteria in both the community and the animal population. At a meeting with the community, the government reports that resistant bacteria is traced to nearby populations of African buffalo and local cattle populations, including those of Thokozani and neighbouring farmers.

The DVS is especially concerned as they refer to research that shows how the mixing of antibiotics into feed to prevent infections such as Black leg can be a driver for antimicrobial resistance (AMR). Furthermore, the representatives caution the community members from eating unwashed vegetables as *E. coli* bacteria resistant to antibiotics, among other *penicillin*, were found in soil samples taken from vegetable plots fertilised with manure from the local cattle farms.

Case vignette 1 discussion, round 2

Additional questions for discussion

What ethical considerations emerge as part of the case?
Are there alternative actions or interpretations of the situation?
How could the situation be addressed?
Identify key knowledge content within your faculty and discipline that is crucial in addressing the challenge highlighted in the case.
How could your faculty and discipline contribute to going from knowing to doing in addressing the challenge of health, food and AMR illustrated in the case?

Case vignette 2: ARVs flowing through poultry into ecosystems and fish

Chikondi has worked for a long-time raising poultry at his small-scale farm for profit to pay for school fees for his children. Recently the cost-per-kilo of producing poultry has gone up due to increased competition from imported Brazilian poultry. In November Chikondi is pressured to draw on any resources available to make his poultry profitable again for the Festive season in late December to cover the upcoming January school fees. As he is diagnosed with HIV/AIDS, he is receiving the antiretroviral (ARV) drug *efavirenz* free of charge from the hospital as part of a government programme. From a neighbour, he heard about poultry farmers giving part of their monthly ARV to the chickens, and how it increased their growth significantly.

Under the dire conditions, Chikondi decides to mix the ARV into the feed of the chickens resulting in quicker growth and bigger chickens to sell by the end of December. With the increased profits he is able to pay the school fees, but the decision turns out to have a number of impacts on human, animal and ecosystem health.

Case vignette 2 discussion, round 1

What happened in the case vignette?
How did it happen?
Why did it happen?
How do you interpret the situation?
Why and How is the case relevant to your faculty and disciplinary background?

Case vignette 2 continued

Firstly, with the increased profits of quicker growth, Chikondi is inclined to continue sharing his prescribed ARVs with the chickens he raises. Over the coming months, this decision has severe implications for his own health as he is often getting sick and less able to take care of his poultry farm. With less energy and more sick days, the farm as a whole suffers, including the vegetables Chikondi grows for sustenance for his family. During a check-up at the hospital, tests show that the reduced ARVs in his body have led to the HIV rapidly multiplying, weakening his immune system. The doctors are also concerned that the less-than-inhibitory concentrations of ARVs in Chikondi´s body could also have long-term health consequences for AIDS patients in driving HIV resistance to the ARV *efavirenz*.

Secondly, regular customers of Chikondi´s chickens begin to complain that while larger the meat is less tasty and they experience it as less nutritious and they begin asking questions about what he has changed in the raising of the chicken and say that they much preferred the old chickens.

Thirdly, as part of safeguarding one of the major fishes contributing to Zimbabwean food security, government and NGOs are monitoring populations of tilapia fish in a nearby river finding liver damage and overall decline in the health of the fish. During a called meeting government representatives inform the community about the findings and how these initial test results could be linked to research coming out of South Africa on how pollution of the ARV efavirenz into aquatic environments like the nearby river is a health risk to *tilapia*. For the community, this is a major concern as many members rely on tilapia as a protein source in their diet and some wonder what other effects the ARVs used by the community members could have on the health of the river.

Case vignette 2 discussion, round 2

Additional questions for discussion

What ethical considerations emerge as part of the case?

Are there alternative actions or interpretations of the situation?

How could the situation be addressed?

Identify key knowledge content within your faculty and discipline that is crucial in addressing the challenge highlighted in the case.

How could your faculty and discipline contribute to going from knowing to doing in addressing the challenge of health, food and AMR illustrated in the case?

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Author contributions
M.M and E.O conceptualized the paper, M.M and E.O developed the methodology; Formal analysis was performed by M.M and E.O, M.M wrote the original manuscript, M.M and E.O conducted manuscript reviewing, revision and editing, M.M prepared Fig. 1, M.M and E.O prepared Table 1. All authors reviewed the manuscript.

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Data availability
Anonymised data presented in this study are available on reasonable request from the corresponding author. The data are not publicly available to ensure the confidentiality and anonymity of participants' details.

Declarations

Ethics approval and consent to participatae
Ethical approval for the project was received from the Medical Research Council of Zimbabwe (MRCZ/A/2920). The study adhered to the principles of informed consent and voluntary participation. Participants were provided consent forms and information sheets detailing the research aims, the workshop process as well as collection and management of research data. Opportunities were provided for participants to raise any questions regarding the research and workshop before going through and signing the consent form, with further opportunities offered during the workshops.

Informed consent
Informed consent was obtained from all individual participants included in the study.

Competing interests
The authors declare no competing interests.

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References

1. Author (2019). [Redacted for anomynised version.]
2. Barter C, Renold E. "I wanna tell you a story": exploring the application of vignettes in qualitative research with children and young people. Int J Soc Res Methodol. 2000;3(4):307–23.
3. Bergold J, Thomas S. Participatory research methods: a methodological approach in motion. Hist Soc Res. 2012;37:191–222.
4. Carlile PR. A pragmatic view of knowledge and boundaries: boundary objects in new product development. Organ Sci. 2002;13(4):442–55.
5. Caudell MA, Dorado-Garcia A, Eckford S, Creese C, Byarugaba DK, Afakye K, Chansa-Kabali T, Fasina FO, Kabali E, Kiambi S. Towards a bottom-up understanding of antimicrobial use and resistance on the farm: a knowledge, attitudes, and practices survey across livestock systems in five African countries. PLoS ONE. 2020;15(1): e0220274.
6. CDDEP. Situational analysis of antimicrobial use and resistance in humans and animals in Zimbabwe. https://onehealthtrust.org/wp-content/uploads/2017/10/SITUATION-ANALYSIS-OF-ANTIMICROBIAL-USE-AND-RESISTANCE-IN-HUMANS-AND-ANIMALS-IN-ZIMBABWE-1.pdf (2017)
7. Converse L, Barrett K, Rich E, Reschovsky J. Methods of observing variations in physicians' decisions: the opportunities of clinical vignettes. J Gen Intern Med. 2015;30:586–94.
8. Crowley K, Head BW. The enduring challenge of "wicked problems": Revisiting Rittel and Webber. Policy Sci. 2017;50(4):539–47. https://doi.org/10.1007/s11077-017-9302-4.
9. Davis K, Ghaffarzadegan N, Grohs J, Grote D, Hosseinichimeh N, Knight D, Mahmoudi H, Triantis K. The Lake Urmia vignette: a tool to assess understanding of complexity in socio-environmental systems. Syst Dyn Rev. 2020;36(2):191–222.
10. Dixon J, Manyau S, Kandiye F, Kranzer K, Chandler CI. Antibiotics, rational drug use and the architecture of global health in Zimbabwe. Soc Sci Med. 2021;272: 113594.
11. Elo, S., & Kyngääs, H. (2008). Thequalitative content analysis process. J Adv Nursing, 62(1), 107–115. https://doi.org/10.1111/j.1365-2648.2007.04569.x
12. Elton L, Thomason MJ, Tembo J, Velavan TP, Pallerla SR, Arruda LB, PANDORA-ID-NET consortium, et al. Antimicrobial resistance preparedness in sub-Saharan African countries. Antimicrob Resist Infect Control. 2020;9:1–11.
13. Essack SY, Desta AT, Abotsi RE, Agoba EE. Antimicrobial resistance in the WHO African region: current status and roadmap for action. J Public Health. 2017;39(1):8–13.
14. Finch J. The vignette technique in survey research. Sociology. 1987;21(1):105–14.
15. Gufe C, Jambwa P, Bare W, Hodobo C, Swiswa S, Waniwa E, Saidi B, Makaya P, Kayoka P. Antimicrobial use and antimicrobial resistance in the poultry value chain in Zimbabwe: a review. Tanzania Vet J. 2023;38(2).
16. Head BW. Political governance of wicked problems. In: Wicked problems in public policy: understanding and responding to complex challenges. Springer; 2022. p. 37–60.
17. Head B W Wicked problems in public policy: Understanding and responding to complex challenges. 2022;Springer Nature.
18. Heldbjerg G, van Liempd D. Vignettes in critical theory investigations. Collaborative research design: Working with business for meaningful findings, pp. 313–340.
19. Jonas OB, Irwin A, Berthe FCJ et al. Drug-resistant infections: a threat to our economic future: final report (English). Washington, D.C.: World Bank Group; 2017.
20. Kathiresan J, Patro BK. Case vignette: a promising complement to clinical case presentations in teaching. Educ Health Abingdon. 2013;26(1):21–4.
21. Kawa NC, Arceño MA, Goeckner R, Hunter CE, Rhue SJ, Scaggs SA, Biwer ME. Training wicked scientists for a world of wicked problems. Humanit Soc Sci Commun. 2021;8(1):1–4. https://doi.org/10.1057/s41599-021-00871-1.
22. Klaassen RG. Interdisciplinary education: a case study. Eur J Eng Educ. 2018;43(6):842–59.
23. Krohn W. Interdisciplinary cases and disciplinary knowledge. The Oxford handbook of interdisciplinarity, 31–49 (2010).
24. Kwakkel JH, Walker WE, Haasnoot M Coping with the wickedness of public policy problems: approaches for decision making under deep uncertainty, Vol. 142, pp. 01816001. American Society of Civil Engineers (2016).
25. Lavery JV. Wicked problems', community engagement and the need for an implementation science for research ethics. J Med Ethics. 2018;44(3):163–4. https://doi.org/10.1136/medethics-2016-103573.
26. Lundy, L. (2007). 'Voice' is not enough:conceptualising Article 12 of the United Nations Convention on the Rights of the Child. British Edu Res J 33(6), 927–942. https://doi.org/10.1080/01411920701657033
27. Mickelsson, M., Kronlid, D. O., & Lotz-Sisitka, H. (2019). Consider the unexpected: scalingESD as a matter of learning. Env Edu Res, 25(1), 135-150.
28. Moyo B, Ndlovu S, Moyo S, Masika P, Muchenje V, Ndhlovu D, Maphosa V. Alternative remedies and approaches used by resources-challenged farmers in the management of cattle black-leg disease in Umzingwane district, Matabeleland South, Zimbabwe. Int J Livest Prod. 2014;6(6):97–102.
29. Munengwa A, Nation C, Alban M. Perceptions and practices on antimicrobial use by the farmers of the Chikomba District, Zimbabwe. Aceh J Anim Sci. 2020;5(2):73–80.
30. Murray, C. J., Ikuta, K. S., Sharara, F., Swetschinski, L., Aguilar, G. R., Gray, A., Han, C.,Bisignano, C., Rao, P., & Wool, E. (2022). Global burden of bacterial antimicrobial resistance in2019: a systematic analysis. The Lancet, 399(10325), 629-655.
31. Murphy J, Hughes J, Read S, Ashby S. Evidence and practice: a review of vignettes in qualitative research. Nurse Res. 2024;32(1).
32. Murray CJL, Ikuta KS, Sharara F, et al. Global burden of bacterial antimicrobial resistance in 2019: a systematic analysis. Lancet. 2022;399:629–55.
33. Nardo A, Gaydos M. 'Wicked problems' as catalysts for learning in educational ethics games. Ethics Educ. 2021;16(4):492–509.
34. Ørngreen R, Levinsen KT. Workshops as a research methodology. Electron J E-Learn. 2017;15(1):70–81.
35. Palaiologou I. The use of vignettes in research with young children. In: Using innovative methods in early years research. Routledge; 2019. p. 138–52.
36. Palczewska M, Pilarski G. Case study method as an interdisciplinary approach to the issue of estimating the security level; 2022.

37. Parthasarathy B, Dey S, Gupta P. Overcoming wicked problems and institutional voids for social innovation: university-NGO partnerships in the Global South. Technol Forecast Soc Change. 2021;173: 121104.
38. Payton KS, Gould JB. Vignette research methodology: an essential tool for quality improvement collaboratives. Healthcare. 2022. https://doi.org/10.3390/healthcare11010007.
39. Ritchey T. 'Wicked problems: modelling social messes with morphological analysis'. Acta Morphologica Generalis 2 (January); 2013.
40. Rittel HW, Webber MM. Dilemmas in a general theory of planning. Policy Sci. 1973;4(2):155–69.
41. Sheringham J, Kuhn I, Burt J. The use of experimental vignette studies to identify drivers of variations in the delivery of health care: a scoping review. BMC Med Res Methodol. 2021;21(1):81.
42. Sartorius B, Gray AP, Weaver ND, Aguilar GR, Swetschinski LR, Ikuta KS, Davis Weaver N, Robles Aguilar G, Mestrovic T, Chung E, Wool EE, Han C, Gershberg Hayoon A, Araki DT, Abd-Elsalam S, Aboagye RG, Adamu LH, Adepoju AV, Ahmed A, Akalu GT, Akande-Sholabi W, Amuasi JH, Amusa GA, Argaw AM, Aruleba RT, Awoke T, Ayalew MK, Azzam AY, Babin F-X, Banerjee I, Basiru A, Bayileyegn NS, Belete MA, Berkley JA, Bielicki JA, Dekker D, Demeke D, Demsie DG, Dessie AM, Dunachie SJ, Ed-Dra A, Ekholuenetale M, Ekundayo TC, El Sayed I, Elhadi M, Elsohaby I, Eyre D, Fagbamigbe AF, Feasey NA, Fekadu G, Fell F, Forrest KM, Gebrehiwot M, Gezae KE, Ghazy RM, Hailegiyorgis TT, Haines-Woodhouse G, Hasaballah AI, Haselbeck AH, Hsia Y, Iradukunda A, Iregbu KC, Iwu CCD, Iwu-Jaja CJ, Iyasu AN, Jaiteh F, Jeon H, Joshua CE, Kassa GG, Katoto PDMC, Krumkamp R, Kumaran EAP, Kyu HH, Manilal A, Marks F, May J, McLaughlin SA, McManigal B, Melese A, Misgina KH, Mohamed NS, Mohammed M, Mohammed S, Mokdad AH, Moore CE, Mougin V, Mturi N, Mulugeta T, Musaigwa F, Musicha P, Musila LA, Muthupandian S, Naghavi P, Negash H, Nuckchady DC, Obiero CW, Odetokun IA, Ogundijo OA, Okidi L, Okonji OC, Olagunju AT, Olufadewa II, Pak GD, Perovic O, Pollard A, Raad M, Rafaï C, Ramadan H, Redwan EMM, Roca A, Rosenthal VD, Saleh MA, Samy AM, Sharland M, Shittu A, Siddig EE, Sisay EA, Stergachis A, Tesfamariam WB, Tigoi C, Tincho MB, Tiruye TY, Umeokonkwo CD, Walsh T, Walson JL, Yusuf H, Zeru NG, Hay SI, Dolecek C, Murray CJL, Naghavi M. The burden of bacterial antimicrobial resistance in the WHO African region in 2019: a cross-country systematic analysis. Lancet Glob Health. 2024;12(2):e201–16.
43. Skilling K, Stylianides GJ. Using vignettes in educational research: a framework for vignette construction. Int J Res Method Educ. 2020;43(5):541–56.
44. Spinuzzi C. The methodology of participatory design. Tech Commun. 2005;52(2):163–74.
45. Swiswa S, Obonyo M, Dube K, Pinto JC, Chandler CI Measurement of antibiotic use on poultry farms in Zimbabwe: Evaluation of a tool and procedures; 2022.
46. Swiswa S, Pinto CJ, Chandler CI. Antimicrobial use/consumption surveillance in Zimbabwe: desk review report; 2022.
47. Tremblay D, Turcotte A, Touati N, Poder TG, Kilpatrick K, Bilodeau K, Roy M, Richard PO, Lessard S, Giordano É. Development and use of research vignettes to collect qualitative data from healthcare professionals: a scoping review. BMJ Open. 2022;12(1): e057095.
48. Van Der Bles AM, van der Linden S, Freeman AL, Spiegelhalter DJ. The effects of communicating uncertainty on public trust in facts and numbers. Proc Natl Acad Sci U S A. 2020;117(14):7672–83.
49. Veloski J, Tai S, Evans AS, Nash DB. Clinical vignette-based surveys: a tool for assessing physician practice variation. Am J Med Qual. 2005;20(3):151–7.
50. Veltman M, Van Keulen J, Voogt J. Teacher strategies that foster students' boundary-crossing expertise when addressing problems with wicked tendencies. J Vocat Educ Train. 2024;76(4):963–90.
51. WHO WHO| Global action plan on antimicrobial resistance. WHO. http://www.who.int/drugresistance/global_action_plan/en/; 2015.
52. Zinsstag J, Schelling E, Crump L, Whittaker M, Tanner M, Stephen C (Eds.). One Health: the theory and practice of integrated health approaches. CABI; 2021.

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