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Editorial Team

From the Editors

Dear JOMES Readers,

We are pleased to present the 11th issue of the *Journal of Mixed Methods Studies (JOMES)*, which brings together four studies exemplifying the analytical depth and integrative strength of mixed methods research across methodological, educational, and social inquiry domains.

In the first article, **"***Methodological Approach to Study the Factors of Adolescents' Pro-Environmental Behavior: Emerging Need of Mixed Methods Research***,"** Shrestha and Bhattarai present a systematic review of research designs used in this field. Their analysis highlights the dominance of quantitative approaches and makes a compelling case for explicitly integrated mixed methods designs to better capture the complexity of adolescents' pro-environmental behavior.

The second contribution, "*Investigation of the 21st Century Skills Levels of Teacher Candidates in Terms of Various Variables*," by Zeynep Ülkü Altun, employs an explanatory sequential mixed methods design to examine preservice teachers' 21st century skills across multiple dimensions. By integrating large-scale quantitative findings with in-depth qualitative insights, the study provides a nuanced understanding of how these skills vary according to academic and demographic variables, while also illuminating teacher candidates' perceptions of teaching and learning in contemporary educational settings.

In the third article, **"***Using a Range of Recruitment Strategies to Recruit Those Who Use Anabolic Androgenic Steroids***,"** Harvey, van Teijlingen, and Parrish present a reflective mixed methods case study addressing the challenges of recruiting hard-to-reach populations. The study provides practical, ethical, and methodological insights into combining online and offline recruitment strategies in sensitive research contexts.

Together, these contributions demonstrate how mixed methods research strengthens methodological rigor, deepens interpretation, and enhances the relevance of scholarly inquiry. We extend our sincere thanks to the authors, reviewers, and readers for their continued support of JOMES.

Sincerely,

Professor Anthony J. Onwuegbuzie
Editor-in-Chief

Professor Şakir Çınkır
Deputy Editor

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Research Article

Methodological Approach to Study the Factors of Adolescents' Pro-environmental Behavior: Emerging Need of Mixed Methods Research

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Abstract
Identifying the factors influencing pro-environmental behavior among adolescents is crucial. Several studies have explored these factors using various methodologies, but the research designs used in those studies have not been systematically examined. To address this gap, a systematic review of previous studies was conducted using PRISMA. The peer-reviewed articles were searched in three databases; Scopus, Web of Science, and Pro-Quest. With selected inclusion and exclusion criteria, 29 articles were reviewed. The results reveal that most past research has relied on quantitative methods. Given the complexity of pro-environmental behavior, a deeper exploration necessitates mixed methods research. Mixed methods research offers a more comprehensive understanding, broadens the scope of the study, provides complementary insights, and enhances validity through triangulation if explicitly integrated the result of two strands. This article is vital for guiding future researchers in examining the determinants of pro-environmental behavior using mixed methods research.

Keywords: *pro-environmental behavior; mixed methods; quantitative; qualitative*

Methodological Approach to Study the Factors of Adolescents' Pro-environmental Behavior: Emerging Need of Mixed Methods Research

Introduction

Sustainable development is highly talked term in present-day society. In order to achieve sustainable development, social, economic, and environmental factors must be balanced (Bezrukova et al., 2019). In line with this perspective, the environment must be taken into account across various aspects of life. Presently, the environment is confronted with numerous issues, such as pollution, water scarcity, species depletion, and global warming (Pielke Jr, 2004), resulting in climate change. Climate change refers to the change in climate directly or indirectly by human activities like deforestation and overconsumption (Pielke Jr, 2004). Thus, United Nations (2023) claimed that it is a severe issue around the world as it has caused adverse environmental consequences like floods, drought, cyclones, landslides, and global warming. Climate change affects people from many generations and geographic regions. Among them, adolescents or youths are the most affected stakeholders (Chan et al., 2021). Therefore, it is essential to have a discourse on PEB among adolescents (Chan et al., 2021).

United Nation Children's Fund [UNICEF] (2023) has defined teenagers between 10-19 years as adolescents. During the adolescent phase of life, they are influenced by different social issues like climate change on their social and cognitive development (Eisenberg et al., 1995). As

explained earlier, climate change affects adolescents, and they must be appropriately guided to engage in environment-friendly behavior (Krettenauer, 2017). This environmentally friendly behavior that protects the environment is termed pro-environmental behavior (PEB) (Palupi & Sawitri, 2018). In order to motivate the adolescents to behave environment appropriate manner, the factor determining the environment friendly behavior of adolescent must be identified.

There have been many studies on factors influencing adolescents' PEB. For example, Uitto et al. (2015) claimed that environment-related attitudes, values, norms and self-efficacies are major factors. Likewise, Pickering et al. (2021) showed climate knowledge, belief, religiosity, and socio-demographic factors determine environment-friendly behavior. In line with this, Stevenson et al. (2018) suggested environmental education can influence adolescents' behavior towards the environment. In like manner, Balundė et al. (2020) put forward personal norms, self-identity, and biospheric values as the determinants of PEB. In this connection, research design carried out to explore the factors is essential to understand.

Researchers can implement quantitative, qualitative, or mixed methods research designs to identify the factors. However, all three research methods have both pros and cons (Kaushik & Walsch, 2019). The quantitative method is guided by post-positivism philosophy, which claims knowledge as an objective reality and standardization (Creswell, 2013). With the quantitative method, the answer to the *what* question can be explored; however, it is difficult to understand the specific setting (Sharma & Bhattrai, 2022). The answer to *how* and *why* is hard to be synthesized by quantitative method. To synthesize the explanation of how and why, qualitative research may be used, which is often guided by constructivist philosophy (Creswell & Plano Clark, 2011). This method is suitable for developing subjective phenomena. However, qualitative research lacks generalizability (Zikmund et al., 2014). Thus, for the situation when an answer to both *what* and *how* or *why* is required, mixed methods research can be performed (Sharma & Bhattarai, 2022). The mixed methods research may provide both objective and subjective reality guided by pragmatism philosophy (Kaushik & Walsh, 2019), which is comprehensive. Many researchers utilized quantitative method for studying PEB (Hosany et al., 2022). For example, the relationship between environmental consideration and PEB among adolescents was investigated using correlation and confirmatory factor analysis (Balundė et al., 2020). Similarly, the recent study using systematic review (Bhattarai et al., 2024) found that many research in the area used quantitative research design (20 out of 21 articles) to determine the factors influencing PEB. In the review, only one study, Dąbrowski et al. (2022), utilized qualitative research design like focus group discussion in their study. The knowledge production on factors influencing PEB among adolescents is increasing (Hosany et al., 2022). However, there have been limited studies on the different aspects of research design, like the data analysis process. The proper research design is essential to understand the complex phenomena of PEB, as highlighted by Chen et al. (2019). The complexity inherent in analyzing the factors influencing PEB necessitates a comprehensive analytical approach such as mixed methods research design which should be monitored continuously for longer period of time (Janakiraman et al., 2021). The research design implemented by previous studies has not been consolidated. Thus, the primary objective of this study is to examine and synthesize the research design employed in existing studies that investigate the factors influencing pro-environment behavior of adolescents. Furthermore, this study aims to explore the extent to which mixed methods research approaches have been utilized in this area and to analyze how these methods have been applied to study the factors affecting PEB of adolescents. In doing so, this article also synthesizes the different data analysis processes. In this way, this study contributes to consolidating the research design used in the study of factors influencing the PEB of

adolescents.

Method

To fulfill the objectives, the researchers of this study implemented a systematic literature review method. As suggested by Nor et al. (2023) and Pradana et al. (2023), a systematic literature review helps to synthesize the knowledge from the existing literature review. It reduces biases, improves dependability, and fosters effective communication of findings. Thus, it is recognized as a desirable approach to review (Liberati et al., 2009). It provides a scientific and reproducible approach (Tranfield et al., 2003). Researchers can follow the procedure more effectively by using the well-explained steps and inclusion and exclusion criteria that a systematic review offers. For performing a systematic literature review, the authors utilize the Preferred Reporting Items for Systematic Reviews and Meta-analysis (PRISMA), which is an established reporting mechanism in the systematic literature review (Hosany et al., 2022).

To perform PRISMA method, a search strategy is vital. The search strategy includes different stages, such as identification, screening, eligibility, and inclusion (Hosany et al., 2022). For identification, the four factors- database, keywords, source types, and language- were considered. The three databases- SCOPUS, ProQuest, and Web of Science (WoS)- were selected for the literature search. The search was performed on April 15, 2025.

The Boolean combinations of keywords for PEB were "environmental behavio*r" OR "pro-sustainability behavio*r" OR "pro-ecological behavio*r" OR "green behavio*r" OR "sustainable behavio*r" OR "ecological behavio*r" OR "eco-friendly behavio*r". Similarly, keywords for adolescents were “adolescen*" OR "youth*" and keywords for methodology were "research method*" OR "Research design*" OR method* OR quantitative OR qualitative OR "mixed methods".

The keywords were searched in the titles, abstract, and keywords of the articles. The search was limited to document-type, openly accessed and available in English articles. For Scopus, the code used for search is TITLE-ABS-KEY (("environmental behavio*r" OR "pro-sustainability behavio*r" OR "pro-ecological behavio*r" OR "green behavio*r" OR "sustainable behavio*r" OR "ecological behavio*r" OR "eco-friendly behavio*r") AND ("adolescen*" OR "youth*") AND ("factor*" OR "determinant*") AND ("research method*" OR "Research design*" OR method* OR quantitative OR qualitative OR "mixed methods")) AND (LIMIT-TO (DOCTYPE , "ar")) AND (LIMIT-TO (LANGUAGE , "English")) AND (LIMIT-TO (OA , "all")). For WoS, the code is TS=(("environmental behavio*r" OR "pro-sustainability behavio*r" OR "pro-ecological behavio*r" OR "green behavio*r" OR "sustainable behavio*r" OR "ecological behavio*r" OR "eco-friendly behavio*r") AND ("adolescent*" OR "youth*") AND ("factor*" OR "determinant*") AND (“research method*” OR “Research design*” OR method* OR quantitative OR qualitative OR “mixed methods”)). The other criteria set to search were open access articles in English language. Finally, the code used for search in ProQuest is ("environmental behavio*r" OR "pro-sustainability behavio*r" OR "pro-ecological behavio*r" OR "green behavio*r" OR "sustainable behavio*r" OR "ecological behavio*r" OR "eco-friendly behavio*r") AND ("adolescen*" OR "youth*") AND ("factor*" OR "determinant*") AND ("research method*" OR "Research design*" OR method* OR quantitative OR qualitative OR "mixed methods") and field selected was Abstract and Document Title and was limited to full-text (open access) and peer reviewed English language scholarly journals. The open access articles were used in all databases as this provides barrier free access which is

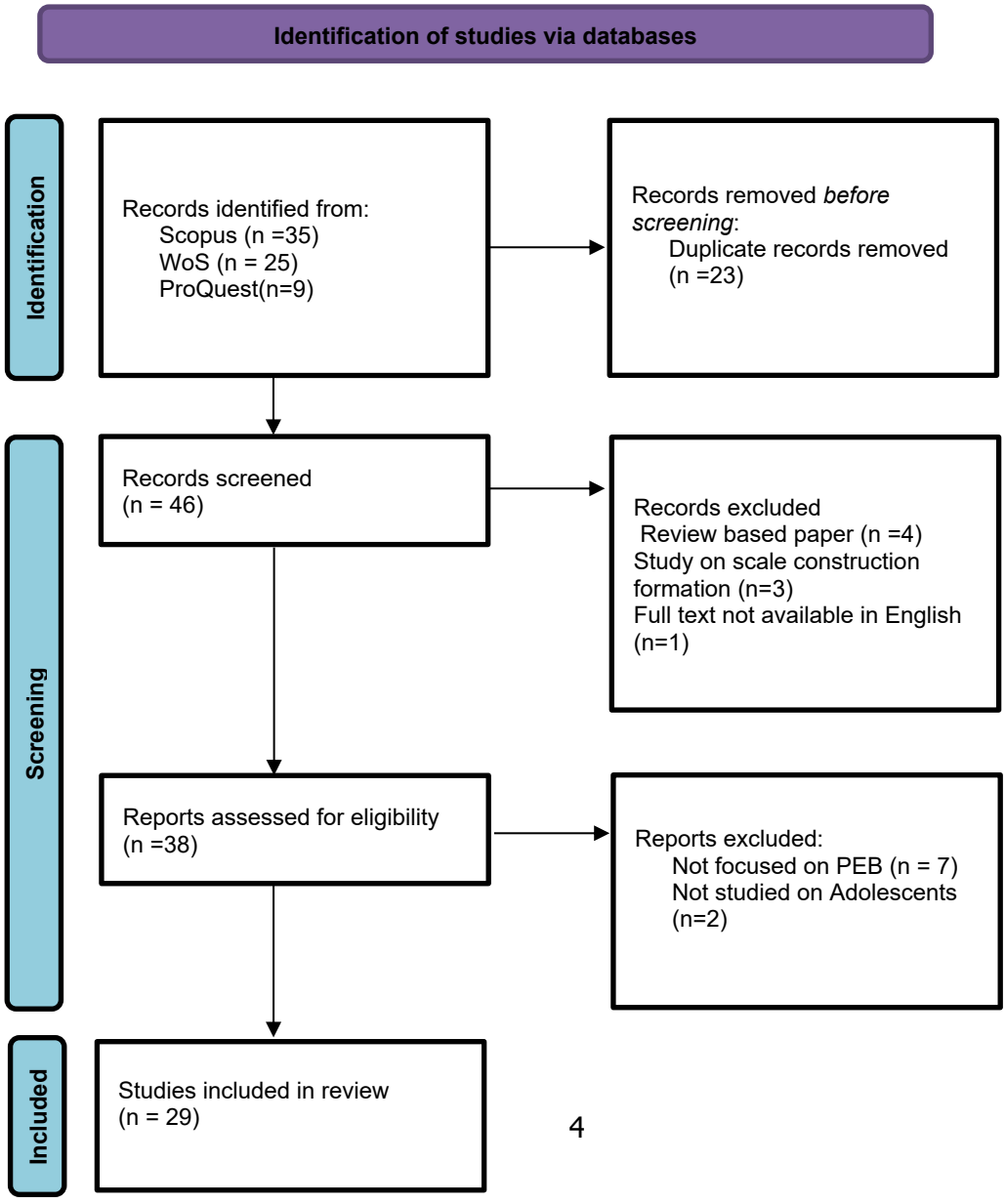
beneficial for the reviewers with limited access to expensive databases and provides transparency in review process (Gusenbauer & Haddaway, 2020). The time limitation was not set for the search in all databases. After the search, 35 articles were identified in SCOPUS, 25 articles were identified in WoS, and 9 articles were identified in ProQuest. Thus, 69 articles were exported to Microsoft Excel for screening and eligibility. 23 duplicates were identified in three databases. After removing duplicates, 46 articles were selected for abstract screening.

Inclusion and Exclusion Criteria

After abstract screening, exclusion criteria were determined. Review based article, study done for scale construction, and full text not available in English were excluded. This resulted in 38 articles for further process. At the end, articles focused on study of pro-environment behavior among adolescents were included for final review. This resulted in 29 articles. Two reviewers (RS and PCB) extracted articles independently to ensure validity. Apart from that all the PRISMA checklist 2020 (Page et al., 2021) were completed. The complete process of PRISMA is shown in Figure 1.

Figure 1

PRISMA Flowchart



Result and Findings

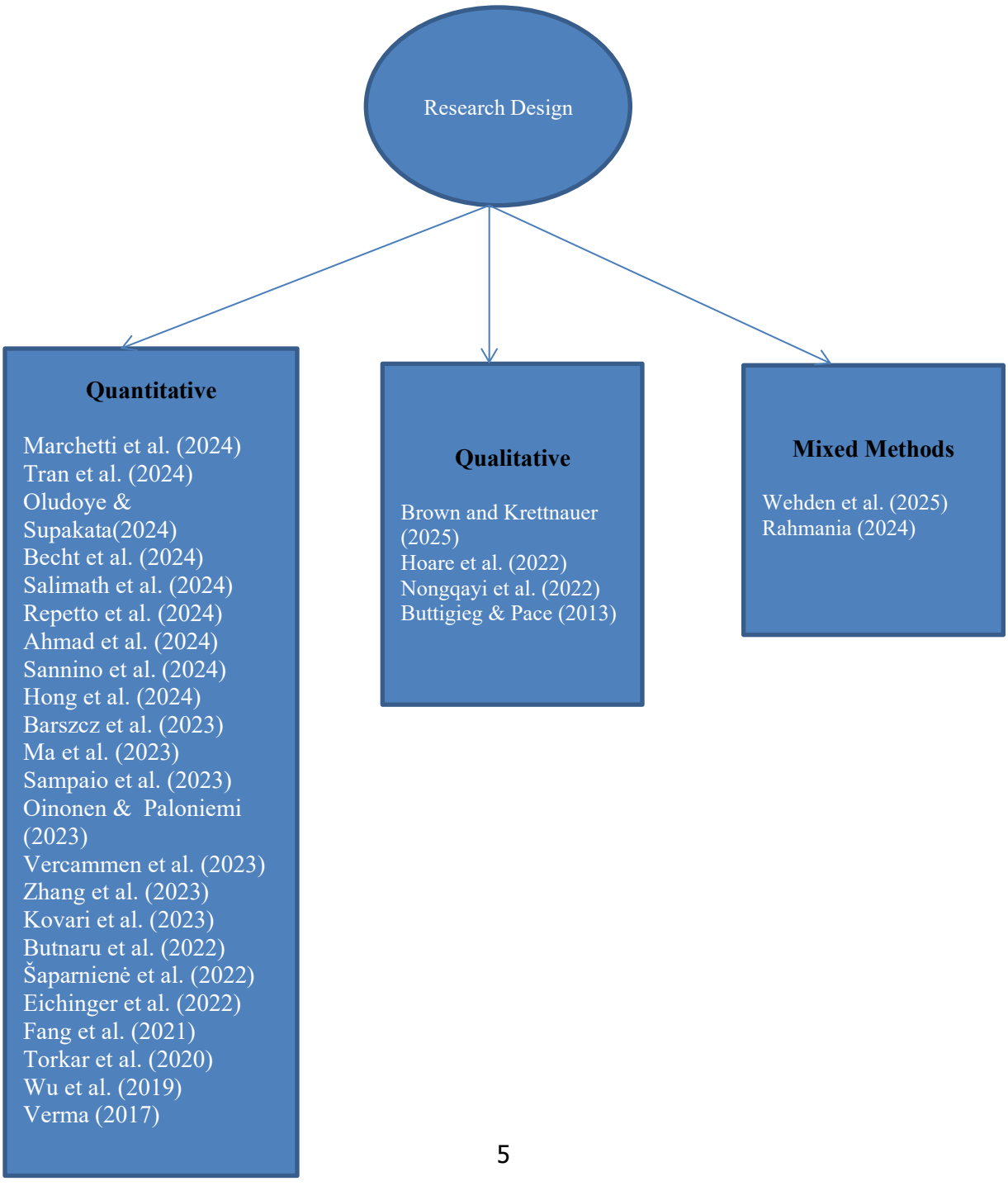
After the in-depth review of 29 articles, researchers here present the findings on methodology of factors influencing PEB among adolescents.

Research Design

Majority of the literatures (*n=23*) have implemented the quantitative research design followed by qualitative research design (*n=4*). Very few literatures (*n=2*) have used mixed methods research design. Figure 2 summarizes the articles and their specific research design.

Figure 2

Research Design



Data Analysis Techniques

Many papers have utilizes the quantitative research design as shown in Figure 2. They have utilized different data analysis techniques like post-hoc, macro process, pearson correlation and regression, factor analysis and structural equation modeling for analyzing the relationship between independent and dependent variables.

Post-Hoc Analysis

Verma (2017) used quantitative research design for understanding green behavior of adolescents. They found out demographic factor like age is important in developing green behavior among adolescents of different era using post-hoc analysis.

Macro Process

Marchetti et al. (2024) utilizes the Pearson correlation to check the association between the variables and process macro for analyzing the mediation effect between independent variables and dependent variables. Likewise, Sannino et al. (2024) analyzed the moderating role of sex of the youth on relationship between environment friendly behavior and divergent thinking using macro process utilizing quantitative research design. They found sex of the youth moderates the association between divergent thinking and environment friendly behavior.

Pearson Correlation and Regression Model

Marchetti et al. (2024) utilizes the Pearson correlation to check the association between the variables. The study of Tran et al. (2024) implemented Baynesian regression analysis with the help of R-programming. Likewise, Becht et al. (2024) also implemented Baynesian regression analysis. Costa et al. (2023) utilizes linear regression to study the relationship between independent variables and dependent variables. Vercammen et al. (2023) utilizes logistic regression and Pearson correlation. Zhang et al. (2023) used regression with two-stage least square methods. Likewise, Barszcz et al. (2023) utilized quantitative survey to determine the factors of pro-environment behavior. They found out intrinsic and extrinsic life goal as important factors determining pro-environment behavior utilizing correlation and regression analysis. Similarly, Salimath et al. (2024) implemented quantitative research design using multiple regression analysis to analyze the factors influencing forest conserving behavior among youths. They found knowledge, age, gender, and information available are some of the major factors influencing forest conserving behavior of youths. In the same line, Repetto et al. (2024) utilized quantitative research design implementing correlation analysis to see the influence of digital learning in climate self-efficacy. With their analysis they claimed that digital learning have more influence on climate self-efficacy among male compared to female adolescents. Similarly, Kővári et al. (2023) used quantitative research design utilizing descriptive statistics and relationship analysis to understand the green attitude of youth of four different European countries. With their analysis, they claimed that difference exist in green attitude among youths based on countries. Furthermore, Eichinger et al., (2022) made cluster controlled pilot study utilizing survey and found out public climate school raises the climate awareness and practice among students implementing logistic regression model. Finally, Fang et al. (2021) utilized multiple regression analysis for analyzing the relationship between independent variables and dependent variables.

Factor Analysis and Structural Equation Modeling (SEM)
Many reviewed papers utilize confirmatory factor analysis (CFA), exploratory factor analysis (EFA), and SEM for data analysis. The study of Torkar et al. (2020) uses CFA for exploring the relationship between students'' dog care and PEB. Likewise, Oludoye and Supakata (2024) used CFA to study the factors influencing the plastic reduction among students and found attitude of students as major factor reducing the use of plastic. Similarly, the study of Šaparnienė et al. (2022) carried out by EFA to study the influence of attitude and behavior on sustainable tourism among youths. Moreover, the study of Ma et al. (2023) utilizes SEM to analyze the relationship between environmental knowledge, environment attitudes, and climate change awareness with their PEB. Likewise, Oinonen & Paloniemi (2023) implemented EFA and CFA for data analysis. Whereas many papers have utilised factor analysis, regression, and SEM separately, the study of Butnaru et al. (2022) utilizes EFA, CFA, and SEM to find out factors influencing environmental behavior. Likewise, Ahmad et al. (2024) made a study on factors influencing curtailment behavior among adolescent. They used quantitative research design utilizing SEM and found government policy moderate the relationship between curtailment behavior and economic concern. Furthermore, Hong et al. (2024) studied green consumption behavior among Chinese youth utilizing quantitative research design. They implemented SEM and found attitude and subjective norms positively influenced green consumption behavior. Likewise, Wu et al. (2019) explored influence of internet use on the formation of environmental attitude among adolescents utilizing quantitative research design using SEM. They claimed level of internet usage influence positively on environmental attitude formation.

Figure 2 shows four papers that have a qualitative research design. They have implemented case studies using focus group discussion (FGD), thematic analysis, and narrative inquiry as data analysis techniques. The study of Hoare et al. (2022) utilizes a case study with FGD as an instrument for interviews to see the influence of conservation education on the coexistence of humans and wildlife. Likewise, Nongqayi et al. (2022) use thematic analysis to understand the knowledge and awareness among youths on human contribution on climate change. Furthermore, Buttigieg & Pace (2013) implement narrative inquiry with in-person interview to understand the youths' role in mitigating climate change. Likewise, Brown and Krettnauer (2025) used qualitative research design using semi-structured interview among adolescents to understand adolescents' pro-environmentalism. They found out nature experience and availability of information is crucial for development of pro-environment behavior.

Two papers in the review applied a mixed methods research design. The study of Wehden et al. (2025) used mixed methods research design integrating case study followed by online survey. They found out occupational choice like photovoltaics installation among German adolescents are key components of pro-environment behavior. However, integration is not purposeful. The connection of integration of results of two research design can be further explained with the techniques like join display. Likewise, Rahmania (2024) explored the influence of environmental and psychological factors on sustainable behavior among students. They utilized the mixed methods research design integrating surveys, interview, and observations, and secondary literature review and found school environment is important in shaping the sustainable behavior among students. This study also could not explicitly discuss the integration of results of two strands.

Discussion: Untapped Potentials of Mixed Methods Research in PEB

The above results show quantitative method dominates the methodological implementation of

the study of factors influencing the PEB of adolescents. However, exploring the determinants of PEB is a multifaceted undertaking, given the intricate nature of individual decision-making processes, as highlighted by Chen et al. (2019). The complexity inherent in analyzing the factors influencing PEB necessitates a comprehensive analytical approach. Singular methodologies may not fully justify the psychological aspects involved in decision-making, potentially limiting the depth of understanding regarding the determinants of PEB. Such a reductionist approach could, in turn, compromise the practical and research implications derived from the study. Thus, assessing pro-environmental behaviors necessitates continuous monitoring and measurement of daily routines over extended periods (Janakiraman et al., 2021), which requires mixed methods for the research.

Worldview of Mixed Methods Research

Researchers using mixed methods research follow the pragmatic worldview. According to Creswell (2009), researchers follow multiple approaches and perspectives for in-depth understanding of the research issues. They integrate a plurality of methods. Researchers implement philosophy and methodology that suits the research problem with a focus on research questions and consequences of research rather than methods (Creswell & Plano Clark, 2011). Pragmatists believe in single or multiple realities open for inquiring empirically and are grounded in the environment and can be realized using human experience (Tashakkori & Teddlie, 2008). According to pragmatist researchers, knowledge is based on each individual's experience gain from their socially shared experience (Kaushik & Walsh, 2019). Pragmatist focuses on practical consequences of human action and beliefs (Morgan, 2014). Thus, researchers following pragmatism implement mixed methods research which has blended characteristics of both quantitative and qualitative research designs providing diverse perspectives in the research issues. The characteristics of mixed methods research has been discussed in next section.

Characteristics of Mixed Methods Research

According to Denzin and Lincoln (2011), mixed methods research poses eight contemporary characteristics that provide diverse perspectives while conducting the research. The eight contemporary characteristics, as stated in Denzin and Lincoln (2011) are as i) methodological eclecticism, ii) paradigm pluralism, iii) emphasis on diversity at all levels of research enterprise, iv) emphasis on continua rather than set of dichotomies, v) iterative and cyclic approach to research, vi) focus on research questions in determining method, vii) set of basic "signature research designs and analytical processes, and viii) tendency towards balance and compromise (p. 287). Methodological eclecticism refers to freedom to combine methods in research for delving into research problems and answer research questions (Tashakori & Teddlie, 2008). Likewise, paradigm pluralism refers to the possible use of multiple epistemologies, theoretical frameworks, and research methodologies in a research (Ghiara, 2020). In the same line, mixed methods research values the perspectives of researchers, participants, and other stakeholders of the research, integrating diversity in the research at all level (Denzin & Lincoln, 2011). Similarly, mixed methods emphasize the interconnectedness of various research methodologies and data integration instead of just focusing on either quantitative or qualitative research design (Teddlie & Tashakkori, 2011). With mixed methods research, researchers can move forth and back for data collection and analysis as guided by the research questions, thus giving flexibility to the researchers (Ivankova & Wingo, 2018). Likewise, mixed methods research provides flexibility to balance and compromise quantitative and qualitative research design and provides

flexibility in the integration of strengths of both qualitative and quantitative research (Benz & Newman, 2008). Finally, mixed methods researchers can implement different signature research designs and approaches like sequential design, embedded design, convergent design, and transformative design (Leavy, 2022). The various approaches are explained in the next section.

Strategies

Many different types of strategies for mixed methods research have been proposed. Among them, the six strategies have been proposed by Creswell and Plano Clark (2011). They are convergent parallel design, explanatory sequential design, exploratory sequential design, embedded design, transformative design, and multiphase design. In convergent parallel design both qualitative and quantitative research are performed separately, and their results are combined to interpret the result. Likewise, in explanatory sequential design, quantitative research is performed first, and the result is explained with the help of qualitative research. Similarly, exploratory research design, at first qualitative research is performed which is followed by quantitative research to generalize the result obtained from qualitative research. In embedded design, researchers add strand of qualitative research to quantitative or vice-versa to improve the interpretation of the result. However, in transformative design, a transformative framework like feminism is considered for prioritizing quantitative or qualitative research design. Finally, in multi-phase design, more than two designs like sequential design and convergent design are implemented over the period to get an in-depth understanding of the research.

In line with Creswell and Plano Clark (2011), the Teddlie and Tashakkori (2011) have suggested five different types of mixed methods research design. The first one is parallel mixed methods design, where both quantitative and qualitative data are collected and analyzed at same time and results are integrated to address the same research question. The second one is a sequential mixed methods design, where one research design is followed by other to answer the research question related to the first design, and other research questions evolved during the process or after the analysis of the first research design. The next one is conversion mixed designs, where one type of data is converted to other types for mixing purposes to answer the same research question. Likewise, the fourth design is multilevel mixed design, where mixing can occur in the sequential or parallel design and in multiple levels to answer the same question. Finally, the fifth design is a fully integrated mixed design where mixing can occur at any stage of research. It is not necessary that mixing occurs only in the findings or results section. It might happen in the conceptualization stage or methodological stage.

Likewise, Morse and Niehaus (2009) suggested eight different types of mixed methods design. The first one is inductive-simultaneous methods (QUAL+quan), where the main research design is qualitative, which is supplemented by a quantitative research design. The second one is inductive sequential design (QUAL->quan), where the core component is qualitative research design, which is supplemented by quantitative research design. Likewise, the third one is deductive-simultaneous design (QUAN+qual), where the main research designs is quantitative and supplemented by qualitative research design. The fourth one is deductive sequential design (QUAN->qual), where the core component is quantitative research design, which is supplemented by qualitative research design. These four designs are mixed methods research design. They have suggested the other four designs as multi-methods designs. For example, the fifth design is inductive simultaneous design (QUAL+qual), where both research designs are

qualitative. Furthermore, the sixth design is inductive sequential design (QUAL->qual) where both are qualitative research designs. Similarly, the seventh design is a deductive simultaneous design (QUAN+quan), where both research designs are quantitative. Finally, the sixth design is deductive sequential design (QUAN->quan), where both are quantitative research designs. The mixed methods research design proposed by Morse and Niehaus has both mixed methods design and multilevel design.

Johnson and Christensen (2017) further provided nine types of mixed methods design integrating equal status or interactive design, which was missing on other designs (Schoonenboom & Johnson, 2017). They are as follows QUAL+ QUAN (equal-status concurrent design), QUAL+quan (qualitatively driven concurrent design), QUAN+qual (quantitatively driven concurrent design), QUAL->QUAN (equal-status sequential design), QUAN->QUAL (equal-status sequential design), QUAL->quan (qualitatively driven sequential design), qual->QUAN (quantitatively driven sequential design), QUAN->qual (quantitatively driven sequential design), and quan->QUAL (qualitatively driven sequential design).

Apart from these designs, another mixed methods research design follows the interactive approach suggested by Loomis and Maxwell (2003). This approach considers design as a process which fits together objectives, conceptual framework, research questions, methods, and validity of the research issues. Thus, the researcher must continuously compare and adapt the components. In this way, researchers have multiple options from various designs to implement in their research. This provides flexibility to the researchers in their study. As per the requirement, researchers can choose specific designs for their issues. Because of flexibility and diverse characteristics, the use of mixed methods design provides an in-depth understanding of the issues. The next section of this study discusses some of the prominent reasons for using mixed methods research design in the study of PEB.

Why is Mixed Methods Research Needed in PEB?

In-depth understanding of phenomena. PEB is complex phenomena with various behaviors like waste management, reducing, recycling, and reusing (Chen et al., 2019). In addition to that, adolescent go through various physical and mental change and sensitive to different societal issues like climate change (UNICEF, 2023). In such condition, it is necessary to have in-depth understanding of PEB phenomenon among adolescents. The mixed methods in the research are used for an in-depth understanding of the phenomena and are becoming popular as both quantitative and qualitative data can be integrated into one single study, providing more robust inference for the research (Creswell, 2013). For example, the importance of mixed methods research stems from its dual approach, merging quantitative surveys with qualitative interviews in the study of Janakiraman et al. (2021). Surveys offer quantifiable insights into level of PEB and attitudinal learning, while interviews explore the intricate experiences of adolescents, revealing how these encounters contribute to the cultivation of PEB among them. Furthermore, different factors influence PEB (Balkenberg & Alhusen, 2019). The utilization of mixed methods, as suggested by Creswell and Plano Clark (2017), allows for a holistic understanding of influence of diverse factors on the issue. Only one method cannot provide such in-depth understanding. For example, in the study of Li et al. (2022), a quantitative survey yielded limited insights into eco-paralysis experiences; the integration of qualitative method facilitated the inclusion of narratives that elucidated the meaning of the quantitative results in a way that a singular method could not achieve.

Expansion of study. Various phenomenon like waste management and recycling indicate PEB and multiple factors like psychological, external, and internal factors influence the PEB among adolescents (Bhattarai et al., 2024). This requires multiple data source which single method cannot provide. However, in mixed methods research, the multiple data sources can be integrated and synergized for assisting complex problems (Poth & Munce, 2020). This provides the wider view or research lens in complex phenomena (Shorter & Smith, 2021) like PEB among adolescents. The justification for opting for a mixed-method approach over a mono-method is twofold (Li et al., 2022). This helps in the expansion of the study. Li et al. (2022) implemented quantitative research in the first phase, which identified the broader spectrum of tourists with diverse environmental profiles. However, to ensure a more comprehensive understanding and validate the quantitative findings, additional context and reality checks were carried out by incorporating qualitative techniques. Thus, mixed methods research can expand study of measuring PEB and identifying factors influencing PEB among adolescents.

Complementary value add-on. The use of two methods in one study acts as complementary, which will add value to the research (Dawadi et al., 2021) like PEB among adolescents. The two methods are used to answer the same research questions. This ensures greater certainty and helps to enrich the understanding of the issue (Morgan, 2014). In line with this, mixed methods incorporate diverse perspectives by combining two methods. It is important to have quantitative and qualitative aspect in the study of PEB among adolescents. While surveys provide measurable information about the degree of PEB and attitudinal learning, interviews delve into the complex lives of teenagers and show how these interactions help them develop PEB. This will ensure the newer research avenues with the enriched comprehension of the phenomena. This approach, as emphasized by Teddlie and Tashakkori (2011), adds value to the research process by offering a more comprehensive and holistic view. Furthermore, the insights gained from mixed-methods research contribute to a better understanding of various components within a phenomenon, facilitating the development of substantial theories, as highlighted by Venkatesh et al. (2013). The findings of quantitative research must be complementary to the findings of qualitative research or vice versa (Li et al., 2022).

Validity through triangulation. One of the values added by mixed methods in research is triangulation of data. This will increase the validity of the research (Dawadi et al., 2021). This is important in the study of PEB among adolescents. The level of PEB might be quantifiable, however, how they practice in different community is difficult to measure as contextual social factor influences the PEB among adolescents (Dąbrowski et al. 2022). This can be achieved by qualitative research. The result of one method cannot provide insights into the issue. Hence, the result of one method can be validated by the result of other methods by comparing two results (Plano Clark & Ivankova, 2016). For example, the study of Janakiraman et al. (2021) validated the quantitative result using the qualitative result to offer enhanced insights into the experience of gameplay. This shows the benefit of employing mixed methods studies. Using mixed methods, a researcher can achieve greater insights using both quantitative and qualitative data (Teddlie & Tashakkori, 2011), which results in the validated conclusion with greater credibility (Venkatesh et al., 2013).

Why is Mixed Methods Research Not Prioritized in Pro-environmental Behavior?

Although mixed methods research provides both qualitative and quantitative perspectives, researchers are reluctant to use mixed methods in research. This is because researchers fear for not achieving goals by using mixed methods in research because of threats associated (Dawadi

et al., 2021). The mixed methods research is lengthy and costly. Studying various indicators of PEB like waste management, recycling, reducing, and reusing (Chen et al., 2019) among adolescents demand prolonged time period. Thus, researchers may not able to finish the research using mixed methods in an estimated budget and time (Hauken et al., 2019).. The PEB of adolescents is influenced by psychological, internal, and external factors (Bhattarai et al., 2024). In mixed methods, there is always difficulty in providing higher priority between the two methods as quantitative and qualitative research design may provide different factors. It is amplified when the findings of one method contradict the findings of other methods (Salehi & Golafshani, 2010). Assessing pro-environmental behaviors among adolescents necessitates continuous monitoring and measurement of daily routines over extended periods (Janakiraman et al., 2021) which is challenge for researchers. Thus, researchers need a broader set of skills for mixed methods research (Dawadi et al., 2021). Hence, with these sorts of challenges, researchers are reluctant to use mixed methods in research like adolescents' PEB.

A Contribution to Mixed Methods Research

As Chen et al. (2019) have highlighted, PEB (Pro-environmental Behavior) has a complex nature. Therefore, relying solely on either qualitative or quantitative research methods may not fully capture the complex psychological factors influencing these behaviors, potentially limiting our understanding of PEB. The reviews of articles in this study also indicate that mixed methods research is crucial for a comprehensive understanding of adolescents' PEB. Additionally, mixed methods research with explicit integration of results from two strands allows for the investigation of environmental behaviors from multiple strategies and perspectives.

Limitations of the Study

Even though this paper has highlighted the research design implemented in the study of factors influencing adolescents' PEB, this study has certain limitations. First, this study only synthesizes the research designs used in studies rather than describing the complete process of methodology. Second, arguments for mixed methods research design is not based on systematic review. Third, the keywords used in the study could have been more for better results. Fourth, only the open access articles have been reviewed. This has limited the implications and conclusion of this study. Fifth, this study did not include ancestral search of articles. This has reduced the opportunity of in-depth synthesis of the research design utilized in the issue. Finally, this study utilized a search from two databases. The inclusion of more databases could have provided different results.

Conclusion

Most of the previous studies implemented quantitative methods for analyzing the factors of PEB among adolescents. However, PEB is a complex phenomenon that requires both objective and subjective perspectives for analysis. Thus, this study highlights the importance of mixed methods in the study of factors influencing the PEB of adolescents and, therefore proposes for implementation of mixed methods research in the study.

This study suggests the benefits of mixed methods research in studying the issue of adolescents' PEB. This method provides an in-depth understanding of PEB, expands the study, validates the result with triangulation, and offers complementary value add-on by implementing both

quantitative and qualitative studies on the issue of PEB. The utilization of mixed methods allows for a holistic comprehension of the diverse influence of factors of PEB. Also, to ensure a more comprehensive understanding of factors influencing adolescents' PEB, both quantitative and qualitative methods need to be integrated. Combining the two methods (mixed methods) provides a more comprehensive understanding of the diverse outcomes found in the current body of literature. However, it is important to explicitly integrate the results of two strands while using the mixed methods research design.

The finding of this study is essential for future researchers to conduct research on the issue of determinants of PEB among adolescents in mixed methods for a holistic comprehension of the diverse influence of factors. Despite posing strengths and benefits, mixed methods research has not been implemented much in the study of PEB among adolescents. The researchers must be trained to conduct and disseminate mixed methods research in a range of pro-environmental behavior research.

Author's Contribution
Conceptualization, R.S. and P.C.B; methodology, R.S. ; validation, R.S and P.C.B,; formal analysis, R.S. and PCB; investigation, R.S.; writing – original draft preparation, R. S.; writing – review and editing, R.S. and P.C.B ; visualization, R.S. and P.C.B, supervision, P.C. B.

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Generative AI has not been used in this study.

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Research Article

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Abstract
The general purpose of this research is to examine the 21st century skills of teacher candidates in terms of different variables and to reveal their opinions about 21st century skills and teaching. For this purpose, explanatory sequential design was preferred in the research, firstly to obtain a general perspective on the 21st century skills of teacher candidates with quantitative data, and then to use qualitative data to explain these findings in more depth in line with the opinions of teacher candidates. In the research, quantitative data were obtained using the "Multidimensional 21st Century Skills Scale" and qualitative data were obtained with the "Semi-Structured Interview Form" created by the researcher. The study population of the research consists of 993 teacher candidates studying at Ankara University Faculty of Educational Sciences, and the sample consists of 379 teacher candidates selected from this population. In the qualitative phase of the research, the study group consists of a total of 12 participants, including 2 teacher candidates from each department within the faculty. When the data obtained in the research are evaluated; Teacher candidates' multidimensional 21st century skills are at a medium level; It was concluded that the lowest level was in the critical thinking and problem solving sub-dimension, and the highest level was in the career awareness sub-dimension. When examined in terms of demographic factors, it was determined that the 21st century skills levels of teacher candidates did not differ according to the variables of gender, mother's education level and father's education level. There is a significant difference according to department and GPA variables; Participants in classroom teaching, preschool teaching, and Computer and Instructional Technologies Teaching departments have higher levels of multidimensional 21st century skills compared to participants in psychological counseling and guidance and special education teaching departments; In terms of GPA, it was determined that participants with a high GPA had more of these skills than those with a medium GPA. In the qualitative part of the research, the participants' opinions were included through direct quotations and these opinions were analyzed by comparing them with the existing literature. Considering the interview data, teacher candidates' definitions of 21st century skills and their views on teaching these skills reveal that their level of knowledge regarding these skills is high. Digital literacy, communication, problem solving, collaboration, critical thinking and creativity are among the basic skills highlighted by teacher candidates. In addition, prospective teachers state that students' acquisition of 21st century skills will positively contribute to their personal development, contribution to society and preparation for their careers. In line with the research results, various suggestions are presented for prospective teachers, relevant institutions and organizations, and future research in the context of 21st century skills.

Key Words: 21st century skills, teacher candidates

P21 Framework for 21st Century Skills

The Partnership for 21st Century Learning (P21), a U.S.-based initiative, developed a comprehensive framework to ensure that students are equipped as competent individuals who meet the demands of the modern era. This framework, shaped through the contributions of

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educators, academics, and representatives from the business world, defines the essential skills students need to thrive in an information-driven society (P21, 2019a).

Internationally recognized, this structure aims to make learning processes active, meaningful, and sustainable, while also empowering individuals in both professional life and civic engagement (Cansoy, 2018).

The P21 framework is organized into three main categories:

1. Learning and Innovation Skills
2. Information, Media, and Technology Skills
3. Life and Career Skills

The framework also includes critical support systems—such as assessment, curriculum, professional development, and learning environments—which play a vital role in the effective instruction of these skills (P21, 2019b).

Learning and Innovation Skills

This category includes skills such as creativity and innovation, critical thinking and problem solving, communication, and collaboration. In a complex and ever-changing world, students need these competencies to generate creative ideas, develop innovative solutions, and analyze diverse perspectives (P21, 2019a; Trilling & Fadel, 2009).

Creativity and innovation refer to individuals' abilities to generate original ideas, perceive failures as part of the learning process, and remain open to change (Öğretir Özçelik, 2019). Critical thinking enhances individuals' capacity to direct both personal and social life through analyzing information, reasoning, and drawing logical conclusions (Paul & Elder, 2006). Problem solving involves the process of drawing upon past experiences to generate effective solutions to present challenges (Karakuş, 2001).

Communication and collaboration skills require individuals to express their thoughts and emotions both verbally and non-verbally, and to work efficiently with others toward shared goals (Hotaman, 2020; P21, 2019a). Teachers, in particular, are expected to model and support these skills within the classroom setting (Yeşildağ Hasançebi, 2021).

Information, media, and technology skills

In today's digital age, individuals' ability to access, evaluate, and ethically use information is of critical importance. This category encompasses information literacy, media literacy, and information and communication technology (ICT) literacy (UNESCO, 2006; P21, 2019a).

Information literacy involves knowing how to access information, analyzing it effectively, and integrating it into real-life problem-solving processes (Warmkessel & McCade, 1997). Media literacy refers to the competence to critically analyze media content, understand various perspectives, and use media tools consciously (RTÜK, 2024). ICT literacy represents the efficient and ethical use of technological tools. In the processes of accessing, analyzing, sharing, and creating information, digital literacy has become a fundamental necessity (ISTE, 2002; P21, 2019a).

In fostering these skills, teachers are expected to enhance their own digital competencies and enrich learning environments through the effective integration of technology (Aydoğmuş & Karadağ, 2020).

Life and career skills

This category enables individuals to succeed both in professional and personal life by developing skills such as flexibility, self-management, productivity, and leadership (PPRC, 2010; P21, 2019a).

Flexibility and adaptability refer to individuals' ability to adjust to changing conditions and communicate effectively in multicultural environments (Trilling & Fadel, 2009). Entrepreneurship and self-management involve setting goals, taking responsibility, and maintaining ownership of one's own learning processes (Sarıtaş & Duran, 2017). Social and cross-cultural skills represent the capacity to establish respectful relationships with individuals from diverse identities (UNESCO, 2006).

Productivity and accountability encompass acting with time management and a sense of responsibility to achieve goals (Gedikoğlu, 2012). Leadership and responsibility include the ability to guide others effectively within a group, demonstrate ethical behavior, and contribute to collective objectives (Fiedler & Garcia, 2005).

21st Century Skills in the Context of the Teaching Profession

Today, teaching is no longer solely about transmitting knowledge; it also encompasses the responsibility of guiding students and managing learning processes. The competencies expected of teachers have evolved in response to technological advancements and globalization (Çalık & Sezgin, 2005). Teachers are now expected to facilitate learning, be open to innovative practices, promote problem solving and critical thinking, and prepare students as individuals equipped with digital literacy skills (Öğretir Çelik, 2009).

In this context, teachers are required to engage in continuous professional development and to design pedagogical strategies aimed at equipping their students with 21st century skills. Qualified teachers contribute not only to individual academic success but also to the development of schools, communities, and the nation at large (Yılmaz, 2011).

As a result of technological developments and globalization, the knowledge, skills, and competencies expected of individuals have significantly changed. Today's learners are expected to demonstrate multifaceted competencies such as problem solving, creativity, critical thinking, and information and technology literacy (Trilling & Fadel, 2009; Griffin, McGaw & Care, 2012). These skills play a crucial role not only in academic achievement but also in individuals' social and professional success. Frameworks developed by national and international organizations (P21, ATC21S, OECD, EU, ISTE) aim to cultivate individuals who are aligned with the knowledge-based structure of 21st-century society (OECD, 2015; ISTE, 2016; P21, 2019a). In Turkey, the Ministry of National Education (MoNE) has also issued various strategic documents and programs to integrate these skills into the national education system (MoNE, 2015, 2017b).

Accordingly, teachers are expected not only to possess these skills but also to demonstrate the pedagogical competence to transfer them to their students (Aydın & Tunagür, 2021). Preservice teachers are the key actors in this process. However, the literature includes very few studies that examine both the skill levels of preservice teachers and their perceptions regarding the instruction of these skills using a mixed-methods approach.

Purpose of the Study

The aim of this study is to examine the level of 21st century skills possessed by preservice teachers in relation to various variables and to analyze their views regarding the instruction of these skills. The research seeks to address the following questions:

1. What are the levels of preservice teachers' skills in information and technology literacy, critical thinking and problem solving, entrepreneurship and innovation, social responsibility and leadership, and career awareness?
2. Do these levels differ based on variables such as gender, department, academic achievement, and parental education level?
3. What are preservice teachers' perspectives on the instruction of 21st century skills?
4. How can the quantitative findings be better understood through the support of qualitative data?

Method

The purpose of this study is to examine the levels of 21st century skills among preservice teachers in relation to various variables. To achieve this aim, a mixed methods approach was employed, specifically utilizing an explanatory sequential design. In the first phase, quantitative data were collected, followed by qualitative data in the second phase to provide deeper insight into the quantitative findings.

Research Design

The quantitative dimension of the study is based on the general survey model, which aims to describe the current situation (Karasar, 2012). For the qualitative dimension, a phenomenological design was adopted, aiming to understand specific phenomena based on individuals' lived experiences (Yıldırım & Şimşek, 2021). The use of a mixed-methods design was preferred to ensure data diversity and enhance the validity of the findings.

Population and Sample / Study Group

The population of the quantitative phase of the study consists of 993 preservice teachers enrolled in the 3rd and 4th years at the Faculty of Educational Sciences, Ankara University, during the 2023–2024 academic year. Using a stratified sampling method, a total of 379 preservice teachers were selected to represent the proportional distribution of programs within the population. Among the participants, 69.1% were female and 30.9% were male. Variables such as academic achievement, department, and parental education level were also taken into consideration. The study group for the qualitative phase was composed of 12 preservice teachers, with two students selected from each teacher education program. Participants were chosen through maximum variation sampling to ensure diversity in terms of gender, academic standing, and grade level.

Data Collection Instruments

Data were collected using three instruments:

The Multidimensional 21st Century Skills Scale (M21CSS): Developed by Çevik and Şentürk (2019), this 41-item, 5-point Likert-type scale consists of five subdimensions: information and technology literacy, critical thinking, entrepreneurship, social responsibility, and career awareness. The overall Cronbach's alpha reliability coefficient was reported as .87, with subdimensions ranging between .43 and .86.

Semi-Structured Interview Form: This form was developed to collect qualitative data. It was constructed in alignment with the scale's subdimensions and refined based on expert feedback.

Personal Information Form: This form was used to gather demographic information about participants, including gender, academic department, grade point average, and parental education level.

Data Collection

Ethical approval and institutional permissions were obtained prior to the data collection process. Quantitative data were collected through face-to-face administration in classroom settings, while qualitative data were gathered via audio-recorded interviews conducted either in person or online.

Data Analysis

Quantitative data were analyzed using SPSS 22.0. In addition to descriptive statistics such as frequency, percentage, mean, and standard deviation, inferential analyses including t-tests and ANOVA were conducted. Assumptions of normal distribution were tested, and where appropriate, group differences were further examined using the LSD post-hoc test.

Qualitative data were analyzed using content and descriptive analysis techniques. MAXQDA Pro 2020 software was employed for data management and coding. The coding process was carried out through an inductive approach, and the analysis was supported with direct quotations from participant interviews.

Validity and Reliability

In the quantitative analyses, the overall reliability of the scale was found to be high ($\alpha = .87$); however, low reliability was observed in the social responsibility subdimension ($\alpha = .43$).

In the qualitative analyses, validity and reliability were ensured based on Lincoln and Guba's (1985) four criteria:

- Credibility: Established through expert review and participant confirmation.
- Transferability: Ensured by providing detailed descriptions of participant characteristics and sample structure.
- Dependability: Achieved through a systematic coding process and supervision by a research advisor.
- Confirmability: Maintained by archiving interview audio recordings, codes, and analytical procedures.

Results

This section of the study presents the findings and interpretations derived from the analysis of quantitative and qualitative data collected from preservice teachers studying at the Faculty of Educational Sciences, Ankara University. The findings and interpretations are organized under headings corresponding to the sub-objectives of the research.

Quantitative Findings

In this section, the analysis results of the Multidimensional 21st Century Skills Scale (M21CSS) regarding the preservice teachers' levels of 21st century skills are presented by addressing each subdimension individually.

Findings on Preservice Teachers' Levels of 21st Century Skills

In the quantitative phase of the study, descriptive statistics of subdimensions and the total scale scores were used to examine how preservice teachers from the Faculty of Educational Sciences at Ankara University perceived their levels of 21st century skills in the areas of information and technology literacy, critical thinking and problem solving, entrepreneurship and innovation, social responsibility and leadership, and career awareness.

Table 1 presents the skewness and kurtosis values for the overall 21st century skills scale and its subdimensions within the preservice teacher dataset.

Table 1

Means, Standard Deviations, Skewness, and Kurtosis Values of the Multidimensional 21st Century Skills Scale (M21CSS)

Scale	Subdimensions	N	$\bar{X}$	Ss	Skewness	Kurtosis
Multidimensional 21st Century Skills Scale	Information and Technology Literacy	379	3,937	0,486	,006	-,137
	Critical Thinking and Problem Solving	379	1,955	0,631	,366	-,234
	Entrepreneurship and Innovation	379	3,233	0,660	,205	-,138
	Social Responsibility and Leadership	379	3,270	0,695	,037	-,318
	Career Awareness	379	4,307	0,549	-,654	-,008
	Total	379	3,340	0,361	,042	-,218

As shown in Table 1, the skewness values range from –.654 to .366, and the kurtosis values range from –.318 to –.008. Based on the acceptable skewness and kurtosis range of –1 to +1 as recommended by Hair, Black, Babin, Anderson, and Tatham (2013), the distribution is considered normal. Additionally, according to the overall mean score of the M21CSS (3.340), preservice teachers are positioned at the "neutral" level, indicating that they possess 21st century skills to a moderate extent.

Table 2 presents the descriptive statistics of the distributions for the overall 21st century skills scale and its subdimensions within the preservice teacher dataset.

Table 2

Descriptive Statistics of Participants' Tendency Levels in Multidimensional 21st Century Skills

Subdimensions	***N***	**X̄**	***Ss***	***Level of Agreement***
Information and Technology Literacy	379	3,937	0,486	Agree
Critical Thinking and Problem Solving	379	1,955	0,631	Disagree
Entrepreneurship and Innovation	379	3,233	0,660	Neutral
Social Responsibility and Leadership	379	3,270	0,695	Neutral
Career Awareness	379	4,307	0,549	Strongly Agree
Multidimensional 21st Century Skills Scale	379	3,340	0,361	Neutral

As shown in Table 2, participants in the study group generally expressed a neutral stance ($\bar{x}$ = 3.340; SD = 0.361) regarding their multidimensional 21st century skills. This suggests that participants tend to evaluate their perceptions of these skills as undecided overall. Among the subdimensions, the highest mean score was observed in career awareness ($\bar{x}$ = 4.307; SD = 0.549), whereas the lowest mean score was in critical thinking and problem solving ($\bar{x}$ = 1.955; SD = 0.631). Additionally, preservice teachers considered themselves competent in "Information and Technology Literacy" skills.

The following section presents whether the preservice teachers' views on their 21st century skill levels differ significantly by gender, academic department, grade point average, and parental education level.

Findings Related to the Gender Variable

An Independent Samples t-test was conducted to examine the scores of preservice teachers on the 21st century skills scale and its subdimensions based on gender. The results of the analysis are presented in Table 3.

Table 3

Examination of Participants' Multidimensional 21st Century Skill Levels by Gender

Subdimensions	**Gruplar**	***N***	**X̄**	***Ss***	**T- test**		
					T	***df***	***p***
Information and Technology Literacy	Female	262	3,907	0,486	-1,783	377	,075
	Male	117	4,004	0,481			
Critical Thinking and Problem Solving	Female	262	1,974	0,655	,895	377	,371
	Male	117	1,911	0,575			
Entrepreneurship and Innovation	Female	262	3,206	0,652	-1,164	377	,245
	Male	117	3,292	0,676			
Social Responsibility and Leadership	Female	262	3,251	0,691	-,816	377	,415
	Male	117	3,314	0,705			
Career Awareness	Female	262	4,352	0,527	2,377	377	,018*
	Male	117	4,208	0,586			
Multidimensional 21st Century Skills Scale	Female	262	3,338	0,355	-,186	377	,853
	Male	117	3,346	0,375			

As shown in Table 3, a statistically significant difference was found in the career awareness subdimension based on gender (t(377) = 2.377, p < .05). Female participants reported higher levels of career awareness ($\bar{x}$ = 4.352; SD = 0.527) compared to male participants ($\bar{x}$ = 4.208; SD = 0.586). However, no statistically significant differences were observed between genders in the subdimensions of information and technology literacy (t(377) = –1.783, p > .05), critical thinking and problem solving (t(377) = 0.895, p > .05), entrepreneurship and innovation (t(377) = –1.164, p > .05), social responsibility and leadership (t(377) = –.816, p > .05), or in the overall multidimensional 21st century skills scores (t(377) = –.186, p > .05).

Findings Related to the Department Variable

Table 4 presents the results of a one-way analysis of variance (ANOVA) conducted to determine whether there are statistically significant differences in the total scores and subdimension scores of the 21st Century Skills Scale among preservice teachers based on their academic departments.

Table 4

Examination of Participants' Multidimensional 21st Century Skill Levels by Academic Department

Subdimensions	Groups	N	X̄	Ss	Source of Variance	Sum of Squares	Sd.	Mean Square	F	p	LSD
Information and Technology Literacy	Elementary Teaching (1)	103	4,033	0,495	Between Groups	4,318	5	,864	3,789	,002**	1-2 1-5 2-4 2-5 6-2 6-3 6-5
	GPC (2)	70	3,788	0,434	Within Groups	85,017	373	,228			
	Early Childhood Education (3)	62	3,891	0,463	Total	89,335	378				
	Social Studies (4)	50	3,964	0,414							
	Special Education (5)	52	3,842	0,506							
	CEIT (6)	42	4,104	0,548							
Critical Thinking and Problem Solving	Elementary Teaching (1)	103	1,948	0,621	Between Groups	,567	5	,113	,282	,923	
	GPC (2)	70	1,981	0,579	Within Groups	150,281	373	,403			
	Early Childhood Education (3)	62	2,024	0,674	Total	150,849	378				
	Social Studies (4)	50	1,920	0,610							
	Special Education (5)	52	1,903	0,606							
	CEIT (6)	42	1,932	0,750							

Entrepreneurship and Innovation	Elementary Teaching (1)	103	3,300	0,656	Between Groups	6,544	5	1,309	3,084	,010**	1-2 2-3 2-6 4-6 5-6
	GPC (2)	70	3,052	0,556	Within Groups	158,317	373	,424			
	Early Childhood Education (3)	62	3,296	0,660	Total	164,861	378				
	Social Studies (4)	50	3,192	0,709							
	Special Education (5)	52	3,105	0,632							
	CEIT (6)	42	3,483	0,720							
Social Responsibility and Leadership	Elementary Teaching (1)	103	3,291	0,789	Between Groups	2,422	5	,484	1,002	,416	
	GPC (2)	70	3,171	0,598	Within Groups	180,357	373	,484			
	Early Childhood Education (3)	62	3,419	0,698	Total	182,779	378				
	Social Studies (4)	50	3,285	0,668							
	Special Education (5)	52	3,201	0,669							
	CEIT (6)	42	3,232	0,656							
Career Awareness	Elementary Teaching (1)	103	4,335	0,522	Between Groups	2,966	5	,593	1,987	,080	
	GPC (2)	70	4,323	0,478	Within Groups	111,343	373	,299			
	Early Childhood Education (3)	62	4,301	0,618	Total	114,309	378				
	Social Studies (4)	50	4,373	0,510							
	Special Education (5)	52	4,099	0,630							
	CEIT (6)	42	4,404	0,525							
Multidimensional 21st Century Skills Scale	Elementary Teaching (1)	103	3,381	0,394	Between Groups	1,698	5	,340	2,654	,023*	1-2 1-5 2-3 2-6 3-5 5-6
	GPC (2)	70	3,263	0,266	Within Groups	47,717	373	,128			
	Early Childhood Education (3)	62	3,386	0,321	Total	49,414	378				
	Social Studies (4)	50	3,346	0,374							

Special Education (5)	52	3,230	0,347
CEIT (6)	42	3,431	0,430

p<0,05, p<0,01, Tek Yönlü Varyans Analizi (ANOVA)*

As shown in Table 4, participants' scores in the subdimensions of critical thinking and problem solving, social responsibility and leadership, and career awareness did not show a statistically significant difference based on their academic departments ($p > .05$). However, a statistically significant difference was found in the information and technology literacy subdimension scores according to participants' departments ($F(5, 373) = 3.789$; $p < .05$). According to the results of the LSD test conducted to identify the source of the difference, participants from the elementary school teaching department scored significantly higher in information and technology literacy compared to those from the guidance and psychological counseling and special education departments. Similarly, participants from the social studies teaching department scored higher than those from the guidance and psychological counseling department; participants from the special education department scored higher than those from the guidance and psychological counseling department; and participants from the computer education and instructional technology department scored higher than those from the guidance and psychological counseling, early childhood education, and special education departments.

In the entrepreneurship and innovation subdimension, participants' scores also differed significantly by academic department ($F(5, 373) = 3.084$; $p < .05$). According to the LSD test results, participants from the elementary school teaching, early childhood education, and computer education and instructional technology departments scored significantly higher than those from the guidance and psychological counseling department. Moreover, participants from the computer education and instructional technology department had higher entrepreneurship and innovation scores than those from the social studies teaching and special education departments.

Finally, a statistically significant difference was found in the overall multidimensional 21st century skills scale scores based on academic department ($F(5, 373) = 2.654$; $p < .05$). LSD test results indicated that participants from the elementary school teaching department scored higher than those from the guidance and psychological counseling and special education departments; participants from the early childhood education department scored higher than those from the guidance and psychological counseling and special education departments; and participants from the computer education and instructional technology department scored higher than those from the guidance and psychological counseling and special education departments in terms of overall multidimensional 21st century skills.

Findings Related to the Grade Point Average (GPA) Variable

Accordingly, Table 5 presents the results of the Kruskal-Wallis H test conducted to determine whether there are statistically significant differences in the subdimensions of the 21st Century Skills Scale based on the grade point average (GPA) variable among preservice teachers.

Table 5

Kruskal-Wallis H Test Results on Differences in Multidimensional 21st Century Skill Levels According to Participants' Grade Point Average (GPA)

Scale and Dimensions	Groups	N	$\bar{x}_{sira}$	x^2	sd	p	Difference
Information and Technology Literacy	Low	21	148.50	15.29	2	**.000**	**Low-High Medium-High**
	Medium	167	170.92				
	High	191	211.24				
Critical Thinking and Problem Solving	Low	21	236.17	4.15	2	**.126**	-
	Medium	167	184.75				
	High	191	189.51				
Entrepreneurship and Innovation	Low	21	161.14	10.44	2	**.005**	**Low-High Medium-High**
	Medium	167	173.24				
	High	191	207.82				
Social Responsibility and Leadership	Low	21	159.17	3.68	2	**.159**	-
	Medium	167	183.34				
	High	191	199.22				
Career Awareness	Low	21	150.88	5.08	2	**.079**	-
	Medium	167	183.14				
	High	191	200.30				
Multidimensional 21st Century Skills Scale	Low	21	166.19	10.66	2	**.005**	**Medium-High**
	Medium	167	172.20				
	High	191	208.18				

As shown in Table 5, no statistically significant differences were found in the subdimensions of critical thinking and problem solving, social responsibility and leadership, and career awareness based on participants' grade point average (GPA) ($p > .05$). However, significant differences were observed in the subdimensions of information and technology literacy, entrepreneurship and innovation, and in the overall scores of the Multidimensional 21st Century Skills Scale ($p < .05$). To determine the direction of these significant differences, Mann-Whitney U tests were conducted. The findings related to these differences are presented below.

Regarding information and technology literacy, significant differences were found between participants with low and high GPAs, as well as between those with medium and high GPAs, in favor of participants with higher GPAs. Similarly, in the entrepreneurship and innovation subdimension, significant differences were observed between participants with low and high GPAs, and between those with medium and high GPAs, again in favor of those with higher GPAs. For the overall Multidimensional 21st Century Skills Scale scores, a significant difference was found between participants with medium and high GPAs, with higher scores favoring those with higher academic performance.

Findings Related to the Mother's Education Level Variable

Table 6 presents the results of a one-way analysis of variance (ANOVA) conducted to determine whether there are statistically significant differences in the total and subdimension scores of the 21st Century Skills Scale among preservice teachers based on their mothers' education levels.

Table 6

Examination of Participants' Multidimensional 21st Century Skill Levels by Mother's Education Level

Subdimensions	Groups	N	X̄	Ss	Source of Variance	Sum of Squares	Sd.	Mean Square	F	p
Information and Technology Literacy	Primary School (1)	179	3,899	0,493	Between Groups	,521	3	,174	,733	,533
	Middle School (2)	54	3,959	0,503	Within Groups	88,815	375	,237		
	High School (3)	92	3,968	0,428	Total	89,335	378			
	Undergraduate (4)	54	3,990	0,539						
Critical Thinking and Problem Solving	Primary School (1)	179	1,929	0,651	Between Groups	,254	3	,085	,211	,889
	Middle School (2)	54	1,969	0,696	Within Groups	150,595	375	,402		
	High School (3)	92	1,972	0,589	Total	150,849	378			
	Undergraduate (4)	54	1,996	0,576						
Entrepreneurship and Innovation	Primary School (1)	179	3,194	0,648	Between Groups	,773	3	,258	,589	,622
	Middle School (2)	54	3,259	0,627	Within Groups	164,088	375	,438		
	High School (3)	92	3,239	0,692	Total	164,861	378			
	Undergraduate (4)	54	3,325	0,681						
Social Responsibility and Leadership	Primary School (1)	179	3,247	0,690	Between Groups	,396	3	,132	,271	,846
	Middle School (2)	54	3,282	0,702	Within Groups	182,383	375	,486		
	High School (3)	92	3,323	0,669	Total	182,779	378			
	Undergraduate (4)	54	3,245	0,760						
Career Awareness	Primary School (1)	179	4,272	0,536	Between Groups	,667	3	,222	,734	,532
	Middle School (2)	54	4,280	0,565	Within Groups	113,642	375	,303		
	High School (3)	92	4,360	0,507	Total	114,309	378			
	Undergraduate (4)	54	4,361	0,645						
Multidimensional 21st Century Skills Scale	Primary School (1)	179	3,308	0,362	Between Groups	,385	3	,128	,980	,402
	Middle School (2)	54	3,350	0,352	Within Groups	49,030	375	,131		
	High School (3)	92	3,272	0,341	Total	49,414	378			
	Undergraduate (4)	54	3,383	0,399						

As shown in Table 6, participants' levels of information and technology literacy, critical thinking and problem solving, entrepreneurship and innovation, social responsibility and leadership, career awareness, and overall multidimensional 21st century skills did not show

statistically significant differences based on the mother's education level variable (p > .05).

Findings Related to the Father's Education Level Variable

Table 7 presents the results of a one-way analysis of variance (ANOVA) conducted to determine whether there are statistically significant differences in the total and subdimension scores of the 21st Century Skills Scale among preservice teachers based on their fathers' education levels.

Table 7

Examination of Participants' Multidimensional 21st Century Skill Levels by Father's Education Level

Subdimensions	Groups	N	X̄	Ss	Source of Variance	Sum of Squares	Sd.	Mean Square	F	p
Information and Technology Literacy	Primary School (1)	117	3,911	0,496	Between Groups	,219	3	,073	,308	,820
	Middle School (2)	68	3,934	0,461	Within Groups	89,116	375	,238		
	High School (3)	112	3,972	0,469	Total	89,335	378			
	Undergraduate (4)	82	3,930	0,518						
Critical Thinking and Problem Solving	Primary School (1)	117	1,968	0,618	Between Groups	3,096	3	1,032	2,619	,051
	Middle School (2)	68	1,779	0,614	Within Groups	147,752	375	,394		
	High School (3)	112	1,968	0,650	Total	150,849	378			
	Undergraduate (4)	82	2,063	0,619						
Entrepreneurship and Innovation	Primary School (1)	117	3,188	0,612	Between Groups	,805	3	,268	,614	,607
	Middle School (2)	68	3,213	0,719	Within Groups	164,056	375	,434		
	High School (3)	112	3,301	0,628	Total	164,861	378			
	Undergraduate (4)	82	3,220	0,720						
Social Responsibility and Leadership	Primary School (1)	117	3,228	0,745	Between Groups	,824	3	,275	,566	,638
	Middle School (2)	68	3,364	0,648	Within Groups	181,955	375	,485		
	High School (3)	112	3,270	0,687	Total	182,779	378			
	Undergraduate (4)	82	3,253	0,674						
Career Awareness	Primary School (1)	117	4,294	0,548	Between Groups	,029	3	,010	,032	,992
	Middle School (2)	68	4,311	0,539	Within Groups	114,280	375	,305		
	High School (3)	112	4,314	0,574	Total	114,309	378			
	Undergraduate (4)	82	4,315	0,536						
Multidimensional 21st Century Skills Scale	Primary School (1)	117	3,318	0,362	Between Groups	,175	3	,058	,445	,721
	Middle School (2)	68	3,320	0,348	Within Groups	49,239	375	,131		

High School (3)	112	3,365	0,350	Total	49,414	378
Undergraduate (4)	82	3,356	0,388			

As shown in Table 7, participants' levels of information and technology literacy, critical thinking and problem solving, entrepreneurship and innovation, social responsibility and leadership, career awareness, and overall multidimensional 21st century skills did not show statistically significant differences based on the father's education level variable ($p > .05$).

Qualitative Findings

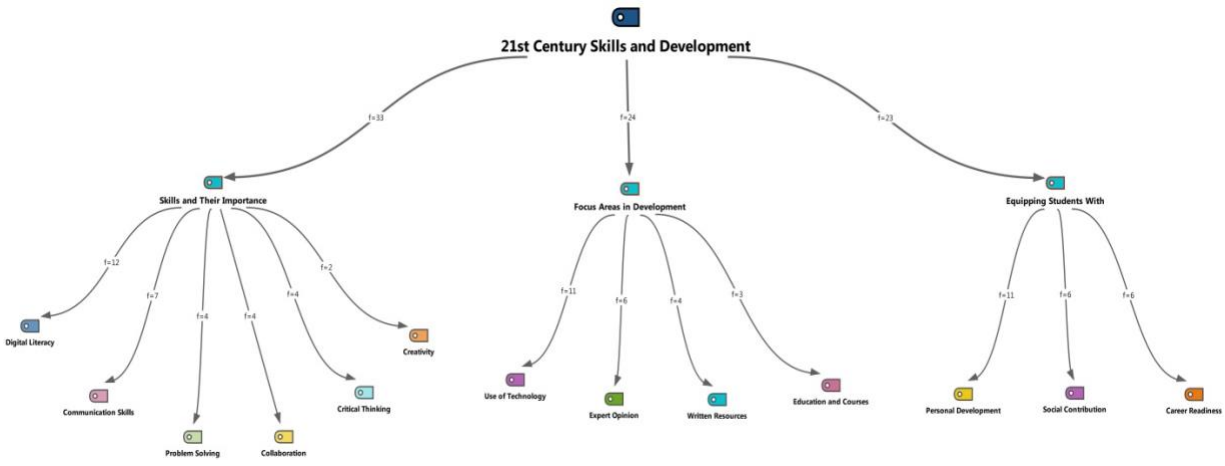
In the qualitative phase of the study, preservice teachers' views on 21st century skills and their instruction were collected through a semi-structured interview form developed by the researcher and are presented below.

Findings on Preservice Teachers' Perceptions of 21st Century Skills and Their Development

Preservice teachers were asked the following questions: "How would you define 21st century skills?", "Why do you think 21st century skills are important?", "What resources do you use to focus on 21st century skills in your own professional development?", and "Can you explain why your students should acquire 21st century skills?". Based on the responses to these questions, the findings were visualized using the hierarchical code-subcode model presented in Figure 1.

Figure 1

Hierarchical Code–Subcode Model of Preservice Teachers' Perceptions of 21st Century Skills and Their Development



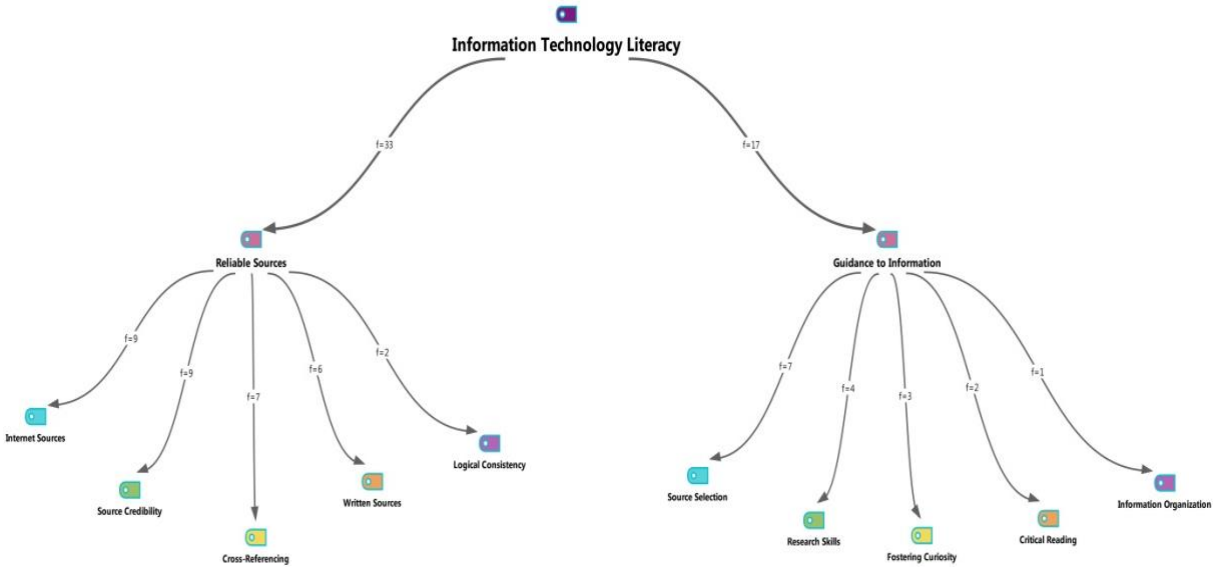
The research findings indicate that preservice teachers conceptualized 21st century skills and their developmental processes under three main themes: Skills and Their Importance, Focus Areas in Development, and Equipping Students With These Skills. The subcodes and frequency values associated with these themes were structured according to the model presented in Figure 1.

Findings on Preservice Teachers' Information Technology Literacy Skills

Preservice teachers were asked the following questions: "How do you identify reliable sources and evaluate the accuracy of information when accessing knowledge?" and "How do you aim to guide your students in researching and evaluating information?" Based on the responses, the emerging themes were organized into a hierarchical code–subcode model, as presented in Figure 2.

Figure 2

Hierarchical Code–Subcode Model of Preservice Teachers' Information Technology Literacy



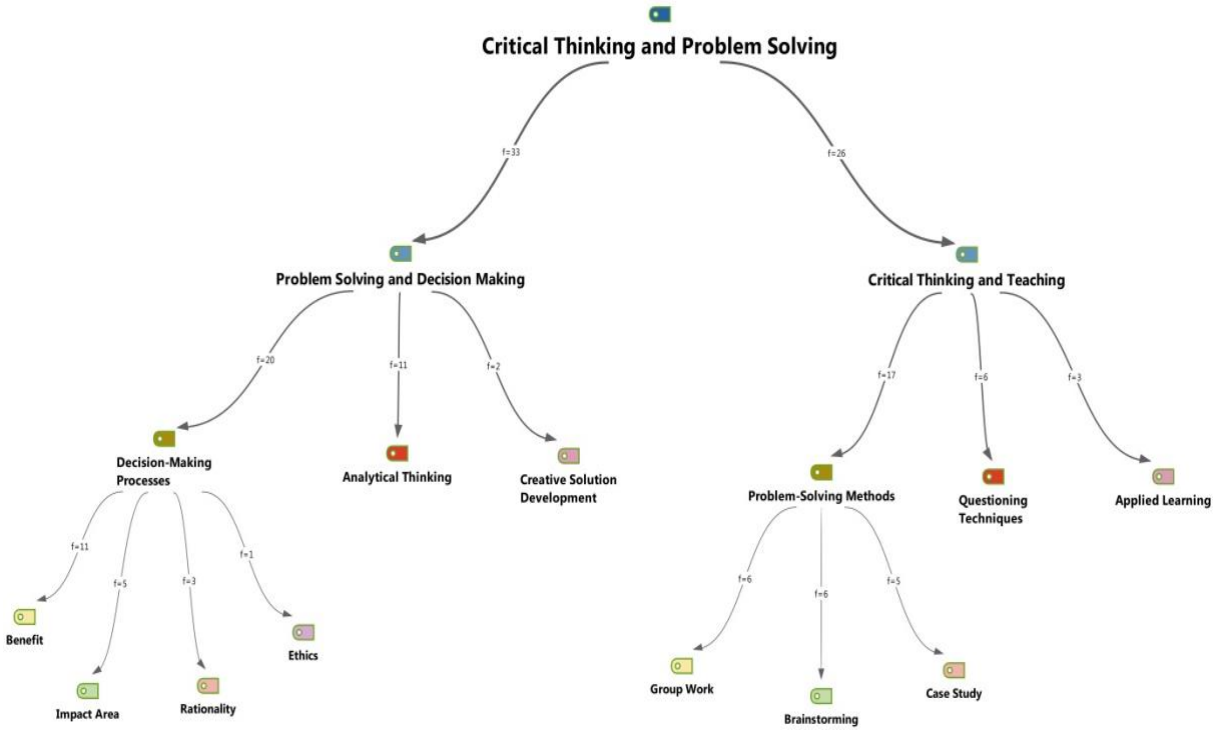
As shown in Figure 2, preservice teachers' views on information technology literacy were categorized under two main themes: Reliable Sources (f = 33) and Guidance to Information (f = 17).

Findings on Preservice Teachers' Critical Thinking and Problem Solving Skills

Preservice teachers were asked the following questions: "What criteria do you prioritize when making a decision about your life or evaluating an idea, and why are these criteria important?", "What types of strategies do you think can be used to develop students' critical thinking skills?", and "Which problem-solving methods do you believe can be taught to students to address learning-related issues in the classroom?" Based on the responses, the findings were structured into a hierarchical code–subcode model, as presented in Figure 3.

Figure 3

Hierarchical Code–Subcode Model of Preservice Teachers' Critical Thinking and Problem Solving Skills



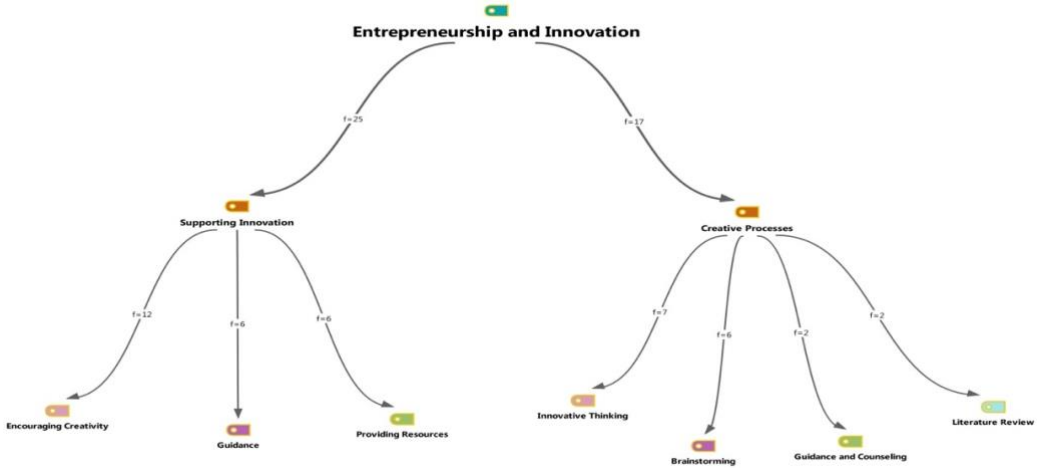
As shown in Figure 3, preservice teachers' views on critical thinking and problem solving skills were grouped under two main themes: Problem Solving and Decision Making (f = 33) and Critical Thinking and Instruction (f = 26).

Findings on Preservice Teachers' Entrepreneurship and Innovation Skills

Preservice teachers were asked the following questions: "What process do you follow when developing a new idea or project? What methods and techniques do you use?", "What do you do to foster students' creativity and innovation skills?", and "How do you guide students in implementing their new ideas?" Based on the responses, the findings were structured into a hierarchical code–subcode model, as presented in Figure 4.

Figure 4

Hierarchical Code–Subcode Model of Preservice Teachers' Entrepreneurship and Innovation Skills



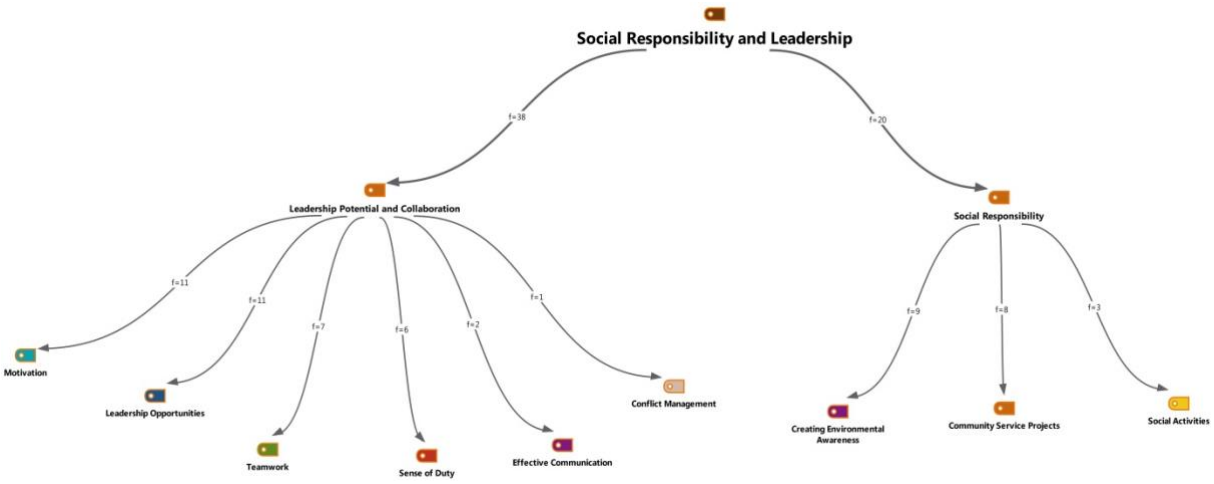
As shown in Figure 4, preservice teachers' views on entrepreneurship and innovation skills were categorized under two main themes: Supporting Innovation (f = 25) and Creative Processes (f = 17).

Findings on Preservice Teachers' Social Responsibility and Leadership Skills

Preservice teachers were asked the following questions: "What strategies do you use to motivate others and promote collaboration when working with a group of students?", "What kinds of activities do you organize to instill a sense of social responsibility in students?", and "What can you do to support students' leadership potential in the classroom or at school?" Based on the responses, the findings were structured into a hierarchical code–subcode model, as presented in Figure 5.

Figure 5

Hierarchical Code–Subcode Model of Preservice Teachers' Social Responsibility and Leadership Skills



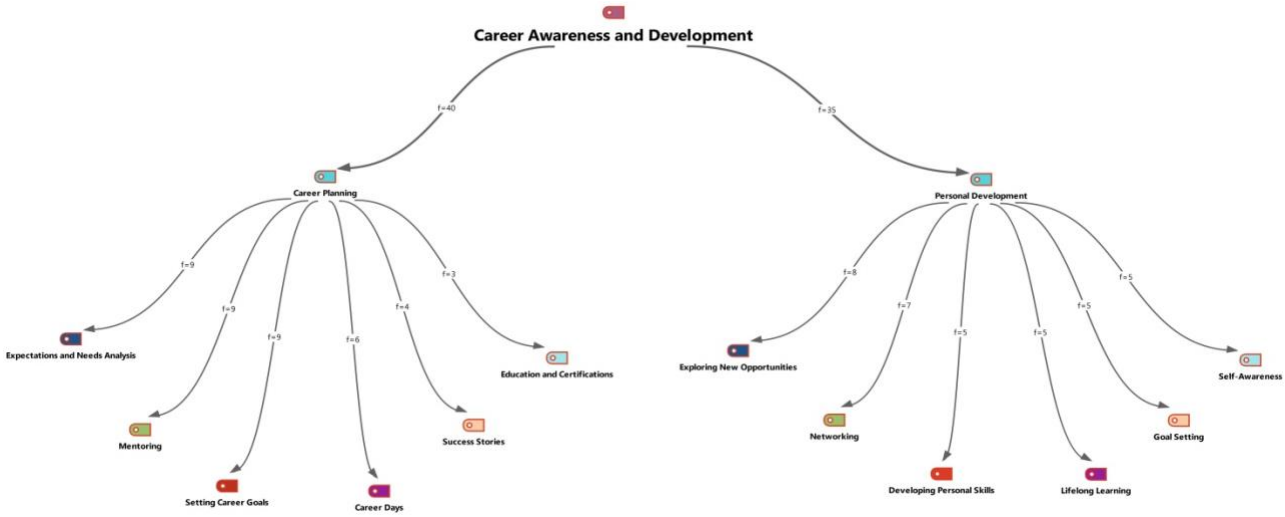
As shown in Figure 5, preservice teachers' views on social responsibility and leadership skills were grouped under two main themes: Leadership Potential and Collaboration (f = 38) and Social Responsibility (f = 20).

Findings on Preservice Teachers' Career Awareness and Development Skills

Preservice teachers were asked the following questions: "How do you research and evaluate opportunities for career advancement?", "How do you help students set their career goals?", and "How do you support students in their professional development and inform them about career opportunities?" Based on the responses, the findings were structured into a hierarchical code–subcode model, as presented in Figure 6.

Figure 6

Hierarchical Code–Subcode Model of Preservice Teachers' Career Awareness and Development Skills



As shown in Figure 6, preservice teachers' views on career awareness and development skills were grouped under two main themes: Career Planning (f = 40) and Personal Development (f = 35).

Discussion and Conclusion

The primary aim of this study was to examine preservice teachers' levels of 21st century skills across various variables and to reveal their perspectives on the instructional processes associated with these skills. The quantitative and qualitative findings obtained offer a holistic reflection of preservice teachers' general competence levels regarding multidimensional skill sets, as well as their perceptions, attitudes, and instructional approaches concerning these skills.

The quantitative results indicate that preservice teachers generally possess a moderate level of 21st century skills. Among the subdimensions, the lowest mean score was observed in "critical thinking and problem solving," while the highest was found in "career awareness." This

suggests that while preservice teachers have a heightened awareness of career planning, they still require further development in higher-order thinking skills. These findings are consistent with those of previous studies such as Bedir (2019) and Valli, Perkkilä, and Valli (2014). Moreover, no significant differences were found based on gender or parental education level, whereas statistically significant differences emerged in relation to academic department and grade point average. Participants from elementary school teaching, early childhood education, and computer education and instructional technology programs demonstrated higher skill levels compared to those in guidance and psychological counseling and special education programs. Similarly, participants with higher academic performance were found to have a greater command of these skills (see Gökbulut, 2020; Mugot & Sumbalan, 2019).

The qualitative findings serve to both support and deepen the quantitative results, indicating that preservice teachers possess a high level of awareness regarding 21st century skills. Participants especially emphasized core skills such as digital literacy, communication, collaboration, problem solving, and creativity. These are also aligned with internationally recognized frameworks (OECD, 2018; P21, 2019a). The instructional strategies participants described for helping students acquire these skills—such as the use of interactive technologies, project-based learning, and real-world problem solving—correspond to constructivist and student-centered approaches (Saavedra & Opfer, 2012).

Another noteworthy theme that emerged was "career awareness." Participants reported managing their careers by researching professional development opportunities, participating in trainings, and engaging with peers. This reflects the importance of fostering career awareness at an early stage in teacher education, as emphasized by Jia et al. (2016). Furthermore, participants viewed leadership, entrepreneurship, and innovation as integral components of career development.

“Social responsibility and leadership” was another prominent theme in the qualitative findings. Participants stated that they organized school-based social responsibility projects, promoted peer mentoring, and engaged in activities aimed at enhancing social consciousness. These findings are in line with global educational objectives as outlined by the European Union (2019) and UNESCO (2017).

Despite their high levels of awareness, some participants also expressed perceived limitations. Notably, a lack of access to current digital resources and limited opportunities for practical application were mentioned as barriers in developing these skills. This supports prior research (e.g., Egan et al., 2017), which emphasizes the importance of complementing theory-heavy teacher education programs with practical, experience-based components.

In conclusion, this study reveals the general competence levels of preservice teachers regarding 21st century skills and their attitudes toward the instruction of these skills. It offers important insights into the capacity of the education system to cultivate individuals who are well-equipped for the demands of the modern era. In today’s educational landscape—shaped by digital transformation, multiculturalism, and rapid change—preservice teachers must be equipped not only with content knowledge but also with skills such as problem solving, creativity, entrepreneurship, leadership, and digital competence. Therefore, teacher education programs must evolve beyond theoretical content to embrace multidimensional structures that incorporate experience-based practices. In doing so, the teachers of the future will not only transmit

knowledge but also guide students in discovering their own competencies and prepare them for the complexities of the 21st century.

Recommendations

Based on the research findings, it is recommended that practice-oriented approaches aimed at fostering 21st century skills be strengthened within teacher education programs. Integrating project-based learning, the use of digital tools, and activities grounded in real-life problems into program content would contribute to preservice teachers' internalization of these skills. Furthermore, in-service training should be provided to faculty members to enhance their competencies in effectively facilitating these skills in classroom settings.

Establishing collaborations among faculties of education, schools, and technology providers is also essential, as such partnerships can create platforms for the dissemination of innovative practices to preservice teachers. Lastly, it is suggested that comparative and longitudinal studies be conducted across different universities to monitor the development of these skills over time.

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Research Article

Using A Range Of Recruitment Strategies To Recruit Those Who Use Anabolic Androgenic Steroids

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Abstract
Collecting data from people who use substances can be challenging. As many now have communities in the digital realm, recruitment via online networks has become a popular method with hard-to-reach participants. This paper seeks to share the pros and cons of different types of recruitment (both online and non-virtually) for those who choose to use androgenic anabolic steroids. **Method**: This case study highlights positive and negative factors to consider for questionnaire design and dissemination via social media platforms and traditional methods. **Findings and Results**: Key lessons with regards to online dissemination via social media include the benefits of using specialist hashtags, access to specialist online fora with respite gatekeeper endorsement, awareness of the impact on reputation for those asked to share, and anonymity. Questionnaire design findings emphasise the importance of piloting the questionnaire, giving consideration to how participants from specific populations may react to the way questions are phrased, and the need for awareness of specific sensitivities of topic of the targeted demographic sub-group. This paper will help sociologists and other social and behavioural science researchers who wish to consider and evaluate their own distribution methods for data collection when it comes to seeking out more hard-to-reach groups.

Keywords: *recruitment, social media, anabolic androgenic steroids, hard-to-reach populations*

Introduction

One way to evaluate a subject is via a reflective case study (Creswell, 1998), consequently this paper seeks to explore the effectiveness of using different methods of recruitment of a hard-to-reach population. It details the different strategies taken and reflects on the success of each strategy.

Hard-to-reach, also known as hidden populations, is a term that encompasses a myriad of reasons and circumstances and refers to those who are perceived as difficult to engage in public participation (Brackertz, 2007). The authors recognise that hard-to-reach is a contested concept (Flanagan & Hancock, 2010) as it can be stigmatising and suggests a level of homogeneity amongst groups (Cook, 2002). It is often used in the context of substance use due to associated stigma (Atkinson, Flint, & Gilbert, 2001). It includes people who choose to use Anabolic Androgenic Steroids (AAS) (Maycock & Howat, 2005; Yu, Hildebrandt, & Lanzieri, 2015) due to the combination of its legal status and AAS-users' experience of stigma (Aycock & Howat, 2005; Yu et al., 2015) which makes them reluctant to disclose their use (Settanni, Prino, Fabris, & Longobardi, 2018; Thorlton, McElmurry, Park, & Hughes, 2012).

There are a range of methods for reaching out to participants from such populations. Questionnaire

surveys are commonly used for data collection across a range of academic fields (Regmi, Waithaka, Paudyal, Simkhada, & van Teijlingen, 2017). There is a wealth of literature discussing the development of online questionnaires (Lumsden, 2007; Regmi et al., 2017; Reynolds, Woods, & Baker, 2007; Whitaker, Stevelink, & Fear, 2017). As early as 2003, Andrews et al. (2003) note that internet questionnaires presented challenges not found in conventional research and predicted that communities were likely to become protective of their online spaces. To address some of the challenges, Joesph et al. (2016, p. 81) suggest the following recruitment approach for smaller projects:

1. Leverage Existing Social Networks And Personal Contacts,
2. Identify And Foster Collaborations With Community Gatekeepers,
3. Develop A Comprehensive List Of Potential Recruitment Platforms And Venues,
4. Create Recruitment Materials That Succinctly Describe The Purpose Of The Study,
5. Build Respectful And Trusting Relationships With Potential Participants.
6.

Several of these strategies were used in this case study, and by sharing their experiences of using a range of communication channels for recruitment the authors hope to add to the knowledge base. Therefore, this article presents a case study on using a range of recruitment methods to seek the experiences, aligned to support needed, for people who choose to use AAS via a questionnaire, with the aim that this may be of benefit to researchers also seeking to recruit from similarly hard-to-engage populations.

Method

Research should be blended in a way that gives the optimal opportunities for achieving the research aims (Johnson & Onwuegbuzie, 2004). The use of one type of data collection is often "inadequate to address the complexity" (Creswell, 2009, p.203) of a topic. A mixed-methods approach uses quantitative and qualitative data collection in parallel (Tashakkori & Teddlie, 2003) and is beneficial when looking for practical implications as it can enhance the interpretation of the results (Bergh, Corley, & Ketchen, 2017). This research project aimed to explore the motivations and experiences of use and how these relate to the support wanted for people who choose to use AAS (Harvey, Parrish, Teijlingen, & Trenoweth, 2020). Therefore, given the complex nature of the varied motivations driving use of AAS across a broad demographic group, one effective way of answering the research questions on support and motivation, was a mixed-methods approach. A quantitative approach would enable the comparison of attributes aligned to motivations and support accessed and test out participants' perspectives aligned to what was already stated in the literature and qualitative data is a way of exploring the richness and complexity of a phenomenon (Burns & Grove, 1999), which can lead to a deeper understanding. Incorporating these two types of data should lead to greater insight into individuals' underlying motivations for use as well as their perceptions and experiences of support services. It was decided not to exclude participants based on nationality, and inclusion criteria were based on age and AAS-use. Ethical approval was gained for this study to be conducted through Bournemouth University Ethics Committee.

Questionnaire Design

The questionnaire itself can impact on recruitment with regard to whether it is deemed credible to complete and share. Consideration was given to the length of the questionnaire, as people are more likely to complete questionnaires of a shorter length (Markstedt & Vernersdotter, 2013; Rolstad, Adler, & Rydén, 2011). However, it can be difficult to separate the impact of content from length (Markstedt & Vernersdotter, 2013); therefore, the length of the questionnaire was determined by the objectives of the study. The ordering of questions is important, as precedent questions can affect how people consider subsequent questions (Fan & Yan, 2010). The participant information sheet and consent check box were placed first to ensure informed consent. The item placement was based on guidelines by Siniscalco et al. (2005) with topics of major interest to the participant such as questions about how they use AAS placed early on, as completing topic-related questions may encourage participants to be more open about

more generic personal questions (Regmi et al., 2017). Questions on behaviour and demographic questions were placed towards the end as behavioural change could be a sensitive subject, due to the societal perceptions relating to 'roid rage', and sensitive questions can provoke resentment or influence responses to other questions (Siniscalco et al., 2005). Views of AAS-users could vary dependent upon their demographics such as gender, age, or motivation for use. Collecting such demographic characteristics would enable the testing of participants' perspectives aligned to what had previously been identified in the literature (Harvey, Keen, Teijlingen, & Parrish, 2019).

The consideration of how questions of gender and sexuality are asked is an important consideration in questionnaire design (Eisenberg, Gower, Brown, Wood, & Porta, 2017). AAS-use is found within homosexual, heterosexual, transgender and genderfluid communities (Guss et al., 2016; Ip et al., 2015, 2017), consequently advice was sought from a nurse practitioner from a local sexual health clinic for lesbians, gays, bisexuals, transsexuals, queers, intersex and asexuals (LGBTQIA+) and an LGBTQIA+ researcher on the phraseology of questions on gender and sexuality. Use of self-describe options can be more empowering and inclusive (Stonewall, 2016) and labelling people can be disempowering (Eisenberg et al., 2017). Therefore, we included a self-describe question on gender and a three-choice question on sexual orientation with a self-describe option (Table 1).

Table 1

Questions On Gender And Sexual Orientation

With what gender do you identify?	**Self-description:**
What is your Sexual Orientation? *(Please tick one)*	Straight/Heterosexual Gay Prefer to self-describe Self-description:…..

Sensitive questions are likely to receive higher nonresponse rates or inaccuracy rates (Olson, 2010). We identified that the question on aggression may be sensitive and therefore juxtaposed this with a question on the benefits of use. One advantage of a web-based questionnaire is that it can be designed to include compulsory questions, i.e., participants must provide an answer before moving on and consideration was given to including such mandatory questions. However, mandating questions can put up a barrier with the respondent, particularly when dealing with a sensitive subject, and may lead the participant to leave the questionnaire (Stieger, Reips, & Voracek, 2007). Therefore, most questions were optional, as use can be emotive due to societal stigma, however, questions on consent eligibility, and support; where a lack of data would limit the potential of the questionnaire to address the primary study question, were mandated. Wright (2005) suggests that you can foster goodwill by offering participants the study results, therefore, therefore, participants could share contact details if they wanted a results summary. In times of data privacy infractions, people might be put off participating in online surveys around sensitive subjects such as AAS use for fear of being outed (Settanni et al., 2018), therefore, the questionnaire was anonymous.

Piloting the questionnaire

Pilot studies are crucial to the design process as they can identify such elements as: assessment of the likely success of research approaches and the identification of any logistical or data analysis problems. When used with questionnaires they can assist in understanding the length of time for completion and identifying any ambiguous or unnecessary questions (van Teijlingen & Hundley, 2001). Expert reviews can identify question problems, which could impact on the gathering of meaningful quality data (Olson, 2010) and visual presentation can strengthen response rates (Dillman, 2007). Therefore, the draft questionnaire was critiqued by a Needle and Syringe Programme (NSP) keyworker, and several

professionals with expertise in substance use, statistics and a visual questionnaire design. It was also piloted on three AAS-users and an ex-user.

Recruitment and Distribution Strategies

This case study used several different non-random sampling methods: opportunity, self-selected (Patton, 2013; Rees, 2011), time-location space and snowballing, which is useful in sensitive areas of research (Shaghaghi, Bhopal, & Sheikh, 2011). Snowballing refers to the method of having a gatekeeper share the questionnaire within the community (Biernacki & Waldorf, 1981). Table 2 outlines the recruitment strategies used with their strengths and limitations.

Table 2

Recruitment and Distribution Strategies

Strategy	Description	Application in this study	Strengths	Limitations
Opportunity	Uses the knowledge of the researcher to identify potential participants (Jupp, 2006)	Contact support organisations for substance users to share survey link. Using own network to share link in their networks. Local supplement shops.	Useful for hard- to-reach populations such as drug users (Goode, 1999). Allows the researcher to define who and where to study (Jupp, 2006)	Perceived from a positive perspective as weak data as it may produce a representative sample of the population (Jupp, 2006).
Self-selected	Participants self-select to undertake the survey (Lavrakas, 2008)	Distribution of the survey link through social media networks and online for a	Useful to reach secretive populations such as drug-users (Lavrakas, 2008)	Introduces self-selection bias which limits data being generalisable to wider population (Lavrakas, 2008).
Time-location space	Identifiable locations which population uses (Karon & Wejnert, 2014)	Contacting NSPs, muscle gyms and online bodybuilding fora	Useful for data collection hard-to-reach populations (Karon & Wejnert, 2014)	Can be difficult to validate. Bias towards those who attend venues, leaves out those who do not attend (Raymond, Ick, Grasso, Vaudrey, & McFarland, 2007).
Snowballing	Gatekeepers share questionnaire (Biernacki & Waldorf, 1981).	Contacting professionals in NSPs and Admin for online user fora, and owners of muscle gyms.	Access participants with rare characteristics and sensitivities (Fielding, Lee, Blank, & Fricker, 2012; Shaghaghi et al., 2011)	Can lead to a more homogenous set of participants (Zahnow et al., 2018) as it relies on referrals from initial respondents to their network (Fielding et al., 2012).

A range of distribution strategies were used to dissemination the questionnaire (Table 3).

Table 3

Summary Of Distribution Methods For Questionnaire

Distribution Channel	Type of Medium
UK NSPs and substance use service providers (non-NHS)	Emailed questionnaire (to allow for paper-version to be completed), poster with online questionnaire link plus business card handouts with questionnaire link
Overseas substance use services: Canada, Australia, USA, Ireland, Jersey	Emailed online questionnaire link.
Work colleagues	Emailed poster and questionnaire link.
Pro-muscle gyms	Emailed poster and questionnaire link.
Friends	Emailed poster and questionnaire link.
Local health food shops & other businesses e.g. library, cafes	Handed out a poster, small business card handouts with questionnaire link.
Twitter	Pinned tweet and sent direct tweets to people who used the hashtag #steroids and substance use services.
Online muscle and bodybuilding fora	Contacted administrators to ask to create a post with questionnaire link
LinkedIn contacts	Sent individual messages to connections with online questionnaire link.
Facebook (FB)	Post of online questionnaire link
Instagram	Posted link alongside pictures of AAS relevant material, used relevant hashtags
Reddit webpage	Posted questionnaire link and study details
YouTube	Created video presentation with link to questionnaire: https://www.youtube.com/watch?v=iOsX1us3-O8

There is a range of different ways to select a non-random sample population (Mason, 2002) and when researching this acknowledged hard-to-reach population (Smith, Hale, Rhea, Olrich, & Collier, 2009), successful engagement can depend upon the researchers' knowledge of the participants in question (Shaghaghi et al., 2011). Support services such as NSPs and gyms are often key recruitment localities (Iversen, Hope, & McVeigh, 2016; Kimergård, 2015), therefore these were included in the strategy. However, as with many hard-to-reach populations, there is a need to understand this sub-group in a wide range of situations and not just limited to those who access support services (Hope et al., 2015). To reduce homogeneity, access non-NSP using members, and attract as diverse a sub-population as possible the researchers targeted muscle gyms, supplement shops and the internet. Previous papers have addressed practical and ethical issues when collecting data using social media (Hennell, Limmer, & Piacentini, 2019; Zindel, 2022). One challenge when distributing questionnaires online, compared with face-to-face in service-led environments, is that researchers are reliant on the integrity of participants regarding such demographics as age, gender and ethnicity as there is no opportunity to verify these.

AAS-use has been linked to the idea of masculinity within Western cultures (Kanayama, Hudson, & Pope Jr., 2012), therefore some targeting of selected high-income countries via emails to NSPs, social media and online muscle fora was undertaken. When considering questionnaire distribution online, it is necessary to consider the potential open global access as, dependent on the population being surveyed there may be different cultural, legal and social contexts. In this case example specifically laws and policies on use. However, evidence from the literature suggested that the AAS-using community sought information on online and studies across Western nations have shown similar motivations (Sagoe,

Andreassen, & Pallesen, 2014). Moreover, it would have been difficult to control the location of the respondents.

Online distribution

The internet can be a valuable resource for recruiting participants from hard-to reach populations, as the anonymity of cyberspace and help encourage people to participate (Rodham & Gavin, 2006) and previous studies have used special interest (bodybuilding) online discussion fora to seek participants (Jennings, Patten, Kennedy, & Kelly, 2014; Papangelis, Chamberlain, & Liang, 2016) as these spaces often have threads and discussion boards devoted to questions on AAS-use.

Due to the immediacy and transient nature of social media, the distribution was an ongoing process and steps were taken to re-share the questionnaire over a range of channels during the recruitment period. People who use AAS often do not discuss their use publicly, except within their own sub-culture networks; therefore, it was difficult to know who within the first author's own networks might know people who used AAS. Therefore, working on the philosophical notion of degrees of separation in social networks (Bakhshandeh, Samadi, Azimifar, & Schaeffer, 2011), an assumption that even if they did not know someone personally, they might share the questionnaire link via their social media, the study was posted on the first and third authors' LinkedIn (a professional networking site). The first author's FB and LinkedIn contacts were direct messaged to ask if they would share the questionnaire link on their social networks.

Twitter, Instagram, YouTube, Reddit

The research team developed a strategy to promote the questionnaire via Twitter (Table 4), including key participant inclusion criteria and a link and QR code to allow for easy access.

Table 4

Promotion Strategy

Step	Description
1	Tweeted the questionnaire link to the first author's Twitter profile.
2	Regularly tweeted AAS-related material using specific hashtags.
3	The third author shared the study on their profile.
4	Searched Twitter for terms such as "steroids" and "roids" to find people interested in AAS. Used direct "@" tweets to ask them to retweet.
5	Used a range of specialist interest hashtags to increase recognition (e.g., #ripped). Examples include: #muscles #muscleworship #bodybuilder #bodybuilding #biceps #abs #pecs #posing #pumped #flex #steroids #shredded #ripped #physique #enhancement #roids #gym #actor #sculpting #roids #gains #harmmin #support #IPED #bodyimage #enhancement #muscleworship #beard #abs #posing #flexing
6	Contacted specific individuals and organizations to ask them to retweet, including: • Substance use agencies, charities, and academics in related fields • People who promoted bodybuilding • Celebrities with significant followership (only one responded: an engineering academic, @markmiodownik) • First author's Twitter followers with large followerships
7	Translated the Tweet into several languages (Bulgarian, Finnish, German, Norwegian, Swedish, Icelandic, French, Danish, Russian, Spanish, Polish, Lithuanian, Hungarian, Greek). Used hashtags such as: #anabola #steroider #muskel #spieren #músculos #esteroides #bodybuilding #steroiden

	#culturismo #steroidy #mięśnie #kulturystyka #lamusculation #stéroïde
8	Translated "Anabolic Androgenic Steroids" into multiple languages and searched for that phrase on Twitter. Directly tweeted users who had used the phrase, asking them to retweet.

Note. Hashtags were used to connect topic-specific online communities ('bubbles') and improve questionnaire visibility within the Image and Performance Enhancing Drugs (IPED) online ecosystem. The strategy involved multilingual engagement, hashtag diversification, and targeted outreach to amplify participation.

Hashtags connect people (Buarki & Alkhateeb, 2018) and topic specific hashtags can be useful to access groups on social media, and in this case making use of twitter 'bubbles' (Teodorowski, Rodgers, Fleming, & Frith, 2022) with sharing by like-minded users. The first author searched Twitter for the types of hashtags that came up when searching for the term 'steroids' and regularly retweeted using relevant hashtags (Table 5). The research team was advised by an NSP worker to use Instagram. Therefore, the first author set up an account and promoted the questionnaire by adding relevant Image and Performance Enhancement Drugs (IPED) related stories to the feed, using hashtags (Table 7) to draw people to the posts.

Table 5

Instagram Hashtags Utilized

Platform	Content
Instagram: Instagram hashtags	#aesthetic #ripped #roids #gym #gymlife #steroids #muscle #powerbodybuilding #strength #physique #fitness #actor #power #fitfam #sculpting #workout #gymrat #gains #bodybuilding #bodybeautiful #workout #instafit Use Anabolic steroids: Share your experiences: Survey link – https://goo.gl/w8N5A1

A pre-recorded PowerPoint on AAS use and harm reduction, which included information about the questionnaire, was posted on a YouTube channel. The first author regularly searched for the most recent posts on YouTube about AAS and, where possible, shared the questionnaire link in the comment sections. No interactions were observed. The questionnaire was also posted on Reddit under the PhD academic study forum, in line with Reddit's guidelines.

Online fora

When it came to Joseph et al's (2016) recommendation regarding using existing social networks and utilising gatekeepers, the researcher contacted moderators of online muscle fora to ask for permission to post, in line with ethical research practice (Rodham & Gavin, 2006). Initially, fora mentioned in previous studies were targeted e.g., UK-muscle and MesoRX.com (Papangelis et al., 2016). A Google search was undertaken to seek out other pro-muscle fora. Papangelis et al. (2016) suggest that one challenge with approaching fora is a possible negative attitude towards researchers, who could be seen as opportunistic outsiders, and invading their safe space. However, another researcher found that some online forums actively welcome research studies and emphasised the need for a level of courtesy by seeking permission to post (Wright, 2005). Moreover, one characteristic of AAS- users is their familiarity with the academic literature (Underwood, 2019), therefore, it seemed reasonable that fora would accept the requests. Wright (2005) suggested researchers could post directly with an apology in advance for an unwanted posting, and notes that concerns have been raised about the length of time it takes gatekeepers to respond. This was discussed by the research team, and was felt to be unprofessional, potentially violating safe spaces and could negatively impact the credibility of the research.

Consequently, permission from moderators was sought to help ensure that privacy was not invaded, and the post was framed as a request focussing on seeking opinions and getting the voices heard.

Specialist Facebook Groups

Several specialist FB groups were directly messaged.

Non-internet distribution routes

UK NSPs and substance use service providers (non-NHS)

Previous studies have sought participants via substance use services (McVeigh & Begley, 2016; Rowe, Berger, Yaseen, & Copeland, 2017) and there has been an increase in recent years in AAS-users accessing NSPs (ACMD 2010). This was a challenge, as in the UK such services are delivered by many different providers and the FRANK website alone had 157 pages of substance use support services (FRANK, 2018). These pages were hand-searched, and a list of potential agencies created and contacted to see if they would share the questionnaire. This was a potentially beneficial route for accessing participants as professionals' relationships with the AAS-users could aid engagement with the questionnaire (Spacey, Harvey, & Casey, 2020). One of the problems with using a service provider is the power imbalance in relationships with clients. This was a concern, however; the questionnaire was anonymous and service users were not being asked to complete it as part of the service provided. As the study had not included NHS ethics, only services not run by, or commissioned by, the NHS could be contacted. As this was a potentially sensitive and stigma-inducing topic, posters with study details, survey link and QR code for discreet and easy phone scanning were created and a business-card sized version that could be slipped discreetly into a pocket.

Clark (2011) argues that it can be challenging to gain the cooperation of gatekeepers and often offering benefits in return, such as training, can help relationship-building as the organisation will get a clear benefit from supporting the research. Three service providers asked the research team to visit their organisation, to talk to the professionals about AAS-use and this opportunity was taken up. Another benefit to an organisation emerged in that one charity who held a number of NSP contracts, offered to promote the study and their support for it on their website. A final benefit was that the research team was able to offer organisations was a summary of the research findings.

Overseas substance use services

To find services overseas in English-speaking countries such as USA, Canada, Ireland, and Australia, the research team searched the internet for websites that listed substance use services.

Local businesses

The researcher visited two local shops selling supplements, as these are often used by AAS-users (Antonopoulos & Hall, 2016; Cafri et al., 2005) and both agreed to take business cards. Posters were put up around the university and in the local town library, as an attempt to reach a broad spectrum of people locally.

Pro-muscle gyms

The research team undertook a Google search of phrases such as: 'hard-core' 'power' and 'muscle' gym to identify potential gyms to target. Some UK gyms that focussed on strength and conditioning were contacted to request if they would share the link.

Results

Questionnaire Design

We received some very emotive responses to the question on aggression, for example:

> *This is bullshit, pure and simple. … I've been around this shit for years and I have never seen mood swings aka 'roid rage', that's just the bad publicity that the newspapers / media keeps feeding us (Rasmus/35/Sweden)*

Even though we had identified that it may be sensitive and had juxtaposed it with a question on the benefits of use. Despite, the care taken with the gender questions (Table 2), these also proved to have an aspect of sensitivity for this group that we had not foreseen, exemplified by these replies from the gender option: 'I'm a fucking man', 'I have a penis' and the self-describes for sexual-orientation (Table 6).

Table 6

Answers To Self-Describe Options For Sexual-Orientation

Sexual Orientation: Self-Describe
– Lean toward gay but minimally involved
– Confident man in his prime
– Happy healthy husband and father of three.
– Entrepreneurial, dedicated, quizzical, ambitious and pursuer of truth and education.
– Bicurious
– Married gay male, 53 years old, HIV+ 22 years
– Software engineer, intelligent, psychology grad

We had only one participant who started the questionnaire but then only completed the consent aspect, however not all participants chose to answer all questions. Eighty-two (61%) respondents ticked the 'yes' to the question on receiving a results summary and gave an email address.

Of the 82 participants who wanted a copy of the results, only 19 of their email addresses had a potentially identifiable surname and first name as part of the address. Many were clearly using pseudonyms designed to help the participant retain their anonymity such as 'johndoe', 'swedishbodybuilder', 'envy'.

Piloting the questionnaire

The feedback from testing the questionnaire with experts prior to the pilot suggested the need for the design style to be more aesthetically pleasing, the answer format to be consistent, the use of language to be less academic and more concise. There was some specific feedback around the question format including discussion on use of 'other' and using 'please describe' instead of 'please explain'. This led to changes in layout to improve usability and flow, fixing errors in the online questionnaire design, and simplifying language to improve clarity and ensure that the questionnaire was pitched correctly. Advice from a mental health practitioner led to the removal of clinical terms when describing psychological effects and this critique also identified that the researcher had missed a potential support group. There were no changes recommended from the pilot with the AAS-users.

Recruitment and Distribution Strategies
Online distribution

Out of 307 people who were directly targeted to retweet, 37 (12%) shared, and 23 people (who followed the researcher) retweeted our tweets without being asked. A basic snapshot of the social media communication and impressions is in Tables 4 and 7.

Table 7

Summary Of Distribution Channels of AAS Questionnaire

Communication Tool	Targeted Populations: questionnaire distribution	Number Contacted	Number Shares Known*	Other known sharing of info or additional steps needed
Email or Phone	UK Support Services for people who use recreational drugs	76	26	2 required to see Ethics approval
Email	Support Services for people who use recreational drugs in US, Canada, Ireland, Australia, New Zealand	72	4	1 required their in-house ethics process
Email	UK Gyms (Pro muscle)	46	1	
Email	Muscle Forum Admins	32		5 allowed Forum posts
In person	Shops selling Supplements	2	2	
Via personal friends with membership of pro-muscle gyms	Local gyms	2	2	
LinkedIn	Personal contacts messaged	213	40	
Facebook	Personal contacts directly messaged	117	29	
Facebook	Posted on personal FB page			7 people re-posted
Facebook	Messaged closed AAS / Testosterone groups to see if they would share		2	Accessed a key gatekeeper
Twitter	People directly tweeted to using @.... and asking them to share questionnaire link	306		37 retweet
Twitter	Unsolicited retweets Twitter users			23 retweets
Instagram	Instagram Users			98 likes in total for posts, and 65 followers gained on the basis of the posts.
Youtube	Narrated PowerPoint Presentation with survey link			27 views

*It is possible that people shared the survey without confirming or telling researchers they were sharing

Use of personal social networks and wider social media channels

Contact through direct messaging was met with a mixed response; 213 contacts were sent a direct message via LinkedIn and 40 (18.7%) agreed to share the link in their personal networks. Of the 117 personal connections contacted via FB messenger, 29 (24.7%) agreed to share the link.

Twitter, Instagram, YouTube, Reddit

Using specific, topic related hashtags was a benefit. There was a distinct difference noted regarding impressions (in that the number doubled) when comparing a tweet without hashtags and one utilising them (Figure 1.).

Figure 1. *Tweet Impression Example: August and September 2018*

Directly targeting celebrities also increased the impact of individual tweets (see Figure 2).

Top media Tweet earned 1,654 impressions **@markmiodownik** Would you be kind enough to share this Study into Anabolic Steroids and Support needed? goo.gl/w8N5A1 pic.twitter.com/k8I09r5VEY

Oct 2017 • 31 days **Top Tweet** earned 926 impressions **@KeirIrwinRogers** Hi, I wonder if you would be kind enough to share this for me? many thanks pic.twitter.com/CWY1S6P0rs

Figure 2*:* Top Tweets

The posting on YouTube of a pre-recorded PowerPoint on AAS use and harm reduction received only 27 views and no interactions were observed in relation to links posted in the comments of any YouTube video thread. There was no engagement on Reddit.

Online for a

Only five fora administrators agreed to the survey being posted (Table 8)

Table 8: Muscle fora that agreed for the questionnaire to be posted in a thread

Muscle Fora:
– UK-Muscle.co.uk
– Tmuscle.co.uk
– Muscle Talk https://www.muscletalk.co.uk/Testosterone-Other-Steroids-f10.aspx
– Forum.bodybuilding.nl
– https://thinksteroids.com/community/threads/please-assist-aas-survey.134390001/

The forum posts generated few comments, although one member endorsed the survey and encouraged others to share (Dec, 21,17), and from this several comments were generated: e.g. '*Nice Survey, I got to say'. A*nother forum member 'bumped' the survey and one member wrote *'Pretty straightforward survey BTW LMAO @ 'take steroids to take part in crime' option'*. Posting in certain fora can impact the participant demographics as the higher number of participants from the Netherlands may be as a result of posting on Forum.bodybuilding.nl (see Figure 3).

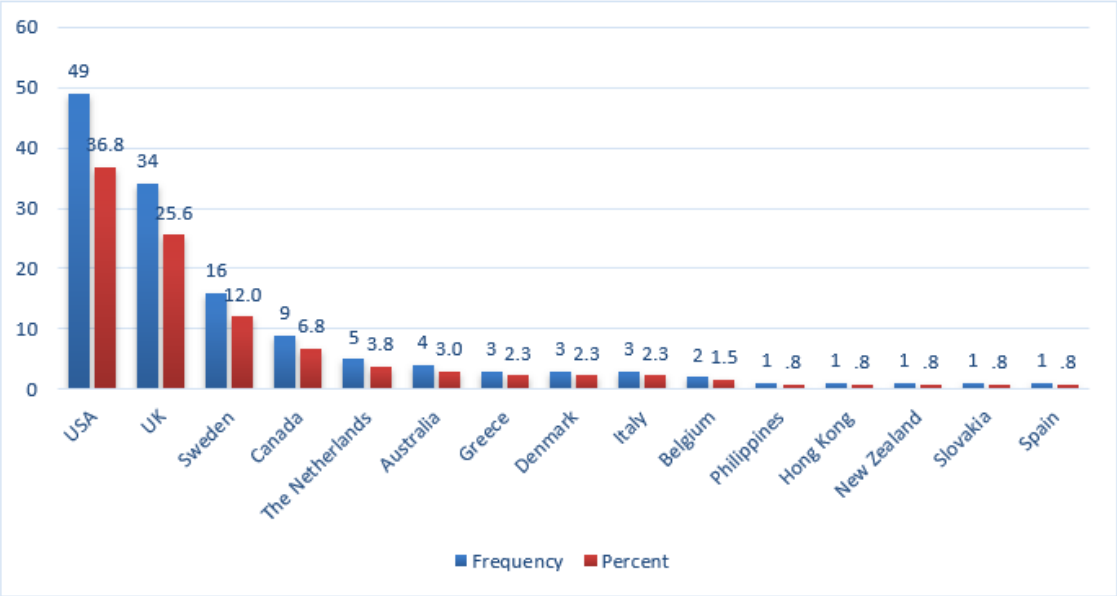

Figure 3*:* Participants by country of residency

Specialist Facebook Groups
Only two closed FB groups agreed to share the post and allowed the researcher to join the group. One group proved beneficial for although the questionnaire did not ask respondents to say where they had found the survey link a number of the those who agreed to be interviewed referenced that they had confidence in the study as it had been posted by someone they respected i.e. the administrator of the FB group.

Non-internet distribution routes

UK NSPs and substance use service providers (non-NHS)

In total, 76 services were contacted, and 26 agreed to share the questionnaire in some format. It was noted that responses from NSPs were heightened when the person working in the service had a particular interest in supporting people who used AAS. No paper copies of the questionnaire was completed.

Overseas substance use services

Approaching services overseas countries did not prove as fruitful as the UK search, as only four

organisations agreed to share the questionnaire.

Local businesses

It is unknown if people accessed the service from seeing it on a poster in a local business, but we suspect not, *as* Figure 3 shows the geographical residence of participants. It is notable over one third came from the USA and the aforementioned closed FB group had a large number of American subscribers.

Pro-muscle gyms

Of the 46 gyms that were emailed, only one responded that they would display a poster.

Discussion, Conclusion and Recommendation

The feedback from experts on questionnaire design and professionals working in the field was valuable, as is evidenced by the fact that no changes were recommended by pilot participants. However, it was not foolproof and on reflection, when it comes to sensitive questions based on our knowledge of AAS use relating to hegemonic masculinity (Börjesson et al., 2021), the answers to the question on gender could potentially have been predicted. This highlights then precarious balance in questionnaire design in terms of being inclusive but also not wanting to offend different diverse subcultures within a sub-group. The offer of a summary of results did appear be a factor in motivating participants to complete the study as 61% respondents shared their contact details, and in line with previous studies anonymity was clearly of importance to this group (Settanni et al., 2018) with many adopting a pseudonym in their personal contact details This is not surprising bearing in mind the stigma that this group experiences and the legal status of AAS use.

Of Joseph et al.'s (2016) recommendations for this participant group the first three steps were all useful with the exception of leveraging personal networks. In terms of commenting on the success of the online distribution, it is difficult to compare this with other studies on this hard-to-reach population to ascertain as to whether this was a positive or typical engagement as although papers on AAS-use report recruitment strategies for online surveys via forums, and websites e.g.(Bonnecaze, O'Connor, & Aloi, 2020; Ip, Barnett, Tenerowicz, & Perry, 2011) the authors could not find one that reported on the efficiency of each of the recruitment different methods.

The least useful method was via personal networks. It is not possible to ascertain how many participants accessed the survey via these methods, and the professional network contacts were less likely to share the link. Using personal networks with such a controversial and sensitive subject, meant that some professional contacts were unwilling to share, with one noting a reputational concern and another not believing they would have any users in their network. Another consideration here is that the authors were not part of the sub-culture. The lack of engagement on Reddit may have been because their rules only allow for research studies to be posted in one area and not targeted at specific groups. Whereas, for YouTube it might have been down to the lack of credibility of the researcher amongst the target population as a more recent study by Bonnecaze et al. (2020) which utilised the one of the authors' YouTube channel had over 2000 participants. Their YouTube channel for the Anabolic Doc (O'Connor, 2021) had 41k of views (as at 7/4/2021) and 408k of subscribers, thus evidencing the influence of those who have already built credibility within the subgroup.

Although use of hashtags and celebrity endorsement of tweets increased the impressions, it was not necessarily an indicator that people accessed the questionnaire. However, the online fora and closed FB groups did seem to be more effective as participants did post that they had completed the questionnaire or commented on the wording of questions. This highlights the importance of peer advocacy. Some of the interviewees commented on being happy to be involved as it was endorsed by the gatekeeper of the

FB group, thus reinforcing the importance of endorsement from key well-respected members of these hard-to-reach communities.

The lack of support from gyms could again be in part that the researcher was not an insider. However, there could also be other reasons for this, for example other studies have found that cold calling via an email, not having a personal connection with the gatekeepers (Spacey, Harvey & Casey., 2020) can impact as could reputational considerations by the managers of the establishments.

Limitations

One key limitation caused by not wanting to add potential unnecessary questions to the survey, was not asking participants where they accessed the survey. This makes it difficult to evaluate the reach and usefulness of some channels. A second is that the research budget did not include funding for Twitter analytics therefore, the research team had to reply on Twitter's basic analytics which are limited in duration and depth. However, the authors hope that these basic statistics will allow novice researchers to reflect on their own methods and consider ways to measure the reach of their own distribution routes. Raymond et al. (2007) note that space/time/location sampling leaves out people who do attend venues, and this could also apply to those who do not use online communities. Pozzar et al. (2020) observed that data from online questionnaires can be compromised by opportunistic individuals who fraudulently complete research surveys for profit, this was not something that had been considered by the research team, and therefore it was unlikely that this would have been an issue, as the research team had consciously decided not to offer any incentives for completion of the survey to discourage those under 18 from taking part, and dissembling about their age and drug use.

Conclusion

Careful consideration at the questionnaire design phase is important. Overall, the most effective recruitment strategy was via online fora and closed FB groups hosted by gatekeepers with credible reputations within the community. Key lessons include the benefits of using specialist hashtags to target specialist interests, the need to continually be promoting tweets using hashtags, seeking out retweets from 'celebrities' with large numbers of followers, access to specialist online fora with respite gatekeeper endorsing the study, an awareness of the nature of the subject and the potential impact on reputation for people or companies being asked to share or endorse, and the need to be aware of specific sensitivities of topic of the demographic hard-to-reach sub-group being targeted. The time take to follow all these different routes to get research participants was time consuming and use of social media was particularly labour intensive. This exploration of using different recruitment strategies can be applied to a wide range of academic disciplines and may be of relevance to researchers seeking information from hard-to-reach populations.

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