Seroja Journal of Empowerment and Community Service

Empowering Researchers through Artificial Intelligence-Assisted Research Instrument Development

Nicholas Renaldo [a*], Kristy Veronica [a], Sulaiman Musa [b], Nabila Wahid [c], Cecilia Cecilia[d]

[a] Faculty of Computer Science, Institut Bisnis dan Teknologi Pelita Indonesia, Indonesia

[b] Faculty of Economics and Management Sciences, Bayero University, Nigeria

[c] Faculty of Business Administration, American International University – Bangladesh, Bangladesh

[d] International College of Chinese Studies, East China Normal University, China

*Corresponding Author: nicholasrenaldo@lecturer.pelitaindonesia.ac.id

Article History
Received
10 October 2025
Revised
5 November 2025
Accepted
31 December 2025
Published
31 January 2026

ABSTRACT

The advancement of Artificial Intelligence (AI) provides new opportunities to improve the efficiency and quality of research activities, particularly in research instrument development. This community engagement program, entitled "Empowering Researchers through Artificial Intelligence-Assisted Research Instrument Development," was conducted through the ICMA program on February 15, 2025. The program aimed to strengthen participants' research competencies by introducing the application of Generative AI, Natural Language Processing (NLP), and Machine Learning (ML) in developing research questions, questionnaires, interview guides, and other research instruments. A participatory training approach was implemented through conceptual presentations, practical demonstrations, hands-on exercises, discussions, and reviews of instrument quality and research ethics. The activity highlighted the potential of AI to support question formulation, indicator identification, language improvement, and the preliminary evaluation of research instruments. The results of the activity indicate that AI can support a more efficient and systematic instrument-development process. However, AI-generated outputs require critical evaluation, theoretical alignment, expert review, pilot testing, and consideration of validity, reliability, privacy, and potential bias. The program emphasized that AI should function as a supporting tool rather than a replacement for researchers. A human-centered approach is essential to maintain methodological rigor, research integrity, and contextual appropriateness. The activity contributes to research capacity building by encouraging researchers to integrate emerging technologies with established research methodology and ethical principles.

Keywords: Artificial Intelligence; Generative AI; Research Instrument Development; Research Methodology; Research Capacity Building; Human-Centered AI

Fields: Research Methodology; Artificial Intelligence; Education

DOI: https://doi.org/10.61230/seroja.v2i1.163

SDGs: Quality Education (4); Industry, Innovation and Infrastructure (9); Peace, Justice and Strong Institutions (16); Partnerships for the Goals (17)

INTRODUCTION

The advancement of Artificial Intelligence (AI) has created new opportunities to improve the efficiency, quality, and accessibility of research activities (Madanchian & Taherdoost, 2025). AI technologies, particularly Generative AI, Natural Language Processing (NLP), and Machine Learning (ML), offer valuable support in various stages of the research process, including research planning, instrument development, data collection, and data analysis. The integration of AI into research methodology has the potential to assist researchers in developing more effective research instruments while reducing the time and effort required during the preparation process.

Research instruments, such as questionnaires, interview guides, and measurement scales, play an essential role in determining the quality of research data (Xu et al., 2025). Well-designed instruments should be relevant to the research objectives, clearly understood by respondents, and capable of measuring the intended constructs. However, researchers, particularly those with limited methodological and technological experience,

may encounter challenges in developing appropriate questions, selecting relevant variables, and ensuring the validity and reliability of research instruments. These challenges highlight the need for innovative approaches that can strengthen research competencies and support the development of high-quality instruments.

Artificial Intelligence-assisted research instrument development provides an opportunity to address some of these challenges (Madanchian & Taherdoost, 2025). Generative AI can assist researchers in brainstorming research questions, developing questionnaire items, preparing interview guides, and improving the clarity of research language. NLP can support the analysis of text and the identification of potentially ambiguous or biased questions, while Machine Learning can assist in identifying patterns and relevant variables from available data. These capabilities may contribute to more efficient and systematic research instrument development when applied appropriately.

Despite its potential benefits, the use of AI in research requires careful consideration (Guetterman et al., 2026). AI-generated instruments may contain inaccurate information, inappropriate questions, or biases resulting from limitations in training data and contextual understanding. In addition, issues related to data privacy, research ethics, transparency, and the interpretation of AI-generated outputs must be addressed. Therefore, AI should be positioned as a supporting tool rather than a replacement for researchers. Human judgment, theoretical understanding, expert review, and empirical testing remain essential in ensuring the quality and appropriateness of research instruments.

In response to these opportunities and challenges, the community engagement program entitled "Empowering Researchers through Artificial Intelligence-Assisted Research Instrument Development" was conducted as part of the ICMA program on February 15, 2025. The program was designed to strengthen participants' research competencies by introducing the practical application of AI in research instrument development. Through an educational and participatory approach, participants were introduced to the potential uses of AI in developing research questions, designing questionnaires and interview guides, improving question clarity, and supporting instrument validation.

The program aimed to empower researchers with practical knowledge and skills to integrate AI into their research activities responsibly and effectively. By combining AI-assisted techniques with human-centered research principles, the activity sought to encourage more efficient, systematic, and ethically responsible research practices. The initiative also emphasized the importance of critical evaluation, expert involvement, and continuous improvement in the development of research instruments.

Through this community engagement initiative, AI-assisted research instrument development is expected to contribute to the strengthening of research capacity and the promotion of technology-supported research practices. The program provides an opportunity for participants to explore how emerging technologies can support academic research while maintaining methodological rigor, research integrity, and the central role of human expertise.

LITERATURE REVIEW

Artificial Intelligence in Research Methodology

Artificial Intelligence (AI) has emerged as a transformative technology with the potential to support various stages of the research process. In research methodology, AI can assist researchers in planning studies, developing research instruments, collecting data, and analyzing research findings. Generative AI, Natural Language Processing (NLP), and Machine Learning (ML) provide opportunities to improve research efficiency and support the development of systematic research procedures.

AI-assisted research methodology emphasizes the use of technology to support researchers in performing methodological tasks while maintaining the importance of human judgment. Generative AI can assist in generating research questions, developing questionnaire items, and preparing interview guides. NLP can support the analysis of textual information, while ML can help identify patterns and relationships within research data. These capabilities provide opportunities for researchers to improve their research practices and develop more structured research instruments.

However, the application of AI in research requires careful consideration of its limitations. AI-generated outputs may not always reflect the specific context of a study, and the quality of the results depends on the information and instructions provided. Therefore, researchers need to evaluate AI-generated content critically and ensure that its use is consistent with research objectives and methodological principles.

Research Instrument Development

Research instruments are essential components of the research process because they provide the means to collect data relevant to research objectives. Common research instruments include questionnaires, interview guides, observation forms, and measurement scales. The development of an appropriate instrument requires a clear understanding of the research problem, theoretical concepts, variables, and characteristics of the target respondents.

The process of research instrument development generally involves identifying research objectives, defining variables and indicators, developing questions or measurement items, selecting response formats, and conducting instrument testing. In quantitative research, instruments should be designed to produce data that can be analyzed statistically. In qualitative research, interview guides and other instruments should support the exploration of participants' experiences, perceptions, and perspectives.

AI can support these activities by assisting researchers in generating initial questions, organizing indicators, improving language clarity, and identifying potentially ambiguous items. Generative AI may also provide alternative formulations of questions based on the intended research constructs. Nevertheless, AI-generated instruments should be considered preliminary drafts that require evaluation and refinement by researchers.

Generative AI for Research Instrument Development

Generative AI refers to artificial intelligence systems capable of producing new content based on user instructions and available information. In research instrument development, Generative AI can be used to support brainstorming, question formulation, questionnaire design, and interview preparation.

One important application is the generation of research questions and questionnaire items. Researchers can provide information about the research topic, target population, variables, and measurement objectives, allowing AI to generate an initial set of questions. These questions can then be reviewed and adapted to ensure that they are relevant to the research context.

Generative AI can also assist in improving the clarity and readability of research instruments. Complex academic language may be simplified to make questions more accessible to respondents. In addition, AI can provide suggestions for identifying ambiguous wording, repetitive questions, and potentially leading statements.

Despite these benefits, the use of Generative AI requires researcher involvement throughout the development process. AI may generate questions that are theoretically inappropriate, lack contextual sensitivity, or fail to represent the intended construct adequately. Consequently, researchers must review AI-generated questions and ensure their alignment with established theories and research objectives.

Natural Language Processing and Machine Learning in Research

Natural Language Processing (NLP) is a branch of AI that focuses on the processing and analysis of human language. In research, NLP can support the development of text-based instruments, including questionnaires and interview guides. It can also be used to analyze textual data obtained from interviews, open-ended survey responses, and other sources.

NLP-assisted research instrument development may include readability analysis, semantic analysis, and the identification of potentially ambiguous language. These applications can help researchers improve the clarity and consistency of questions. NLP may also assist in comparing questions with relevant theoretical concepts and identifying areas that require further review.

Machine Learning (ML), another important component of AI, can support the identification of patterns and relationships in research data. In the context of instrument development, ML may assist researchers in identifying relevant variables, analyzing response patterns, and exploring relationships among measurement items. Techniques such as clustering and feature selection can provide additional information to support the refinement of research instruments.

Although these technologies offer valuable support, their outputs should not be interpreted as definitive evidence of instrument quality. Statistical analysis and theoretical evaluation remain necessary to determine whether an instrument appropriately measures the intended constructs.

Validity and Reliability of AI-Assisted Research Instruments

Validity and reliability are fundamental considerations in research instrument development. Validity refers to the extent to which an instrument measures the concept or constructs it is intended to measure. Reliability concerns the consistency of measurement results under appropriate conditions.

Several forms of validity are relevant to research instrument development. Content validity concerns the extent to which an instrument adequately represents the important aspects of a construct. Construct validity concerns the relationship between the instrument and the theoretical construct being measured. Face validity relates to whether the instrument appears clear, relevant, and appropriate to respondents.

AI can assist researchers in reviewing research questions, comparing items with theoretical concepts, and identifying possible weaknesses in wording. NLP-based tools may also support readability analysis and the identification of ambiguous expressions. These applications can contribute to the initial review and refinement of research instruments.

Reliability can be evaluated through methods such as internal consistency and test-retest reliability. Internal consistency examines the degree to which items within an instrument provide consistent measurements, while test-retest reliability examines the stability of measurements over time. AI may assist researchers in organizing data and supporting statistical analysis, including the calculation and interpretation of reliability measures.

However, AI-assisted analysis does not replace empirical testing. Researchers must conduct appropriate validation and reliability procedures using relevant data and established methodological standards. Expert review and pilot testing remain important to ensure that instruments are suitable for their intended use.

Human-Centered Research and Ethical AI Use

The integration of AI into research methodology should be guided by human-centered research principles. Human-centered research emphasizes the importance of understanding the needs, experiences, and contexts of individuals involved in the research process. In instrument development, this principle requires researchers to consider the characteristics of respondents, the clarity of questions, and the cultural and social context of the study (Suyono et al., 2021).

AI may support researchers in identifying potentially biased or unclear questions, but it cannot always recognize complex cultural meanings or contextual differences. Therefore, researchers should combine AI-assisted techniques with expert knowledge and direct consideration of respondent perspectives.

Ethical considerations are also important in the use of AI for research. Data privacy, confidentiality, transparency, and responsible use of AI-generated outputs should be addressed throughout the research process. Researchers should avoid entering sensitive participant information into AI systems without appropriate safeguards. In addition, AI-generated content should be critically evaluated to maintain research integrity and prevent inappropriate reliance on automated outputs.

The responsible integration of AI therefore requires a balance between technological innovation and human expertise. AI can improve efficiency and provide methodological support, but researchers remain responsible for the quality, validity, and ethical appropriateness of their instruments.

Research Capacity Building through AI-Assisted Training

Research capacity building refers to efforts to strengthen the knowledge, skills (Suhardjo et al., 2023), and competencies required to conduct research effectively. Training programs are important mechanisms for improving researchers' understanding of research methodology and introducing new technological approaches.

AI-assisted training can provide researchers with practical experience in developing research questions, preparing questionnaires, organizing interview guides, and reviewing instrument quality. Through participatory learning activities, participants can explore the capabilities and limitations of AI while developing the ability to evaluate AI-generated outputs critically.

The integration of AI into research training is particularly relevant for researchers who face challenges in developing research instruments and adopting emerging technologies. By introducing AI as a research assistant, training programs can support more efficient research practices while emphasizing the importance of theoretical understanding, methodological rigor, and ethical responsibility.

In this context, the community engagement program entitled "Empowering Researchers through Artificial Intelligence-Assisted Research Instrument Development" focuses on strengthening research competencies through practical training. The program emphasizes the responsible use of AI in research instrument development and encourages participants to integrate technological tools with human judgment and established research principles.

Conceptual Framework

The literature review highlights the relationship between AI-assisted research instrument development and research capacity building. AI technologies provide tools that can support instrument design, language improvement, and preliminary evaluation. These capabilities may contribute to improved research efficiency and methodological understanding when combined with appropriate training and human oversight.

The conceptual framework of this community engagement program is based on the following components:

1. AI Technology: Generative AI, NLP, and ML as supporting tools in research instrument development.
2. Research Instrument Development: The process of identifying research objectives, developing questions, and preparing questionnaires or interview guides.
3. Human-Centered Validation: Expert review, theoretical alignment, pilot testing, and consideration of respondent characteristics.
4. Research Capacity Building: Improvement of participants' knowledge, practical skills, and confidence in using AI for research.
5. Responsible Research Practice: Ethical, transparent, and critical use of AI in research methodology.

The framework assumes that practical training in AI-assisted research instrument development can support researchers in improving their methodological competencies. However, the effectiveness of this approach depends on the quality of training, participants' prior knowledge, and their ability to critically evaluate AI-generated outputs.

METHODOLOGY

Community Engagement Design

This community engagement program employed a participatory training approach to introduce the use of Artificial Intelligence (AI) in research instrument development (Renaldo, Suyono, et al., 2023). The activity was designed to strengthen participants' research competencies through theoretical explanations, practical demonstrations, and hands-on exercises. The training focused on the application of Generative AI, Natural Language Processing (NLP), and Machine Learning (ML) as supporting tools in the research process.

The program was conducted as part of the ICMA activity on February 15, 2025. The training emphasized the responsible integration of AI into research methodology, particularly in developing research questions, designing questionnaires, preparing interview guides, and supporting instrument evaluation.

Participants and Training Context

The participants were researchers and members of the academic community involved in research activities. The training was intended to support participants in improving their understanding of AI-assisted research instrument development and strengthening their ability to use AI tools in methodological tasks.

The activity was conducted in the context of the ICMA program. Detailed information regarding the number of participants, participant characteristics, and training location was not specified in the available activity description.

Training Materials and Learning Content

The training materials were developed based on the principles of research methodology and the application of AI in research instrument development. The learning content covered the following topics:

1. Introduction to Artificial Intelligence in research methodology.
2. Identification of research objectives and relevant research variables.
3. Development of research questions and questionnaire items using Generative AI.
4. Application of NLP to improve question clarity and identify potential ambiguity.
5. Use of Machine Learning to support the identification of relevant variables and response patterns.
6. Validity and reliability considerations in AI-assisted research instruments.
7. Ethical considerations, data privacy, and responsible use of AI in research.

The materials were designed to provide participants with both conceptual understanding and practical knowledge of AI-assisted research instrument development.

Training Implementation Procedures

The training was implemented through several interconnected stages.

Stage 1: Introduction and Orientation

The activity began with an introduction to the role of AI in research methodology. Participants were introduced to the potential benefits and limitations of AI in developing research instruments. The orientation emphasized the role of AI as a supporting tool rather than a replacement for researchers.

Stage 2: Presentation of Research Instrument Development Concepts

Participants received explanations regarding research objectives, variable identification, questionnaire development, interview guide preparation, and instrument evaluation. This stage provided the methodological foundation required before applying AI tools.

Stage 3: Demonstration of AI-Assisted Instrument Development

The facilitators demonstrated how Generative AI could be used to generate research questions and questionnaire items based on a specific research topic. Participants were introduced to the importance of providing clear instructions regarding research objectives, target respondents, variables, and measurement indicators.

Stage 4: Practical Exercise and Participant Discussion

Participants were encouraged to practice developing research instruments using AI-assisted techniques. The practical activity focused on formulating questions, improving wording, and reviewing the relevance of generated items. Discussion and interaction were used to encourage participants to identify potential weaknesses and improve their understanding of the process.

Stage 5: Review of Instrument Quality and Ethical Considerations

The final stage emphasized the importance of evaluating AI-generated instruments through theoretical review, expert judgment, and appropriate validity and reliability testing. Participants were also introduced to ethical considerations, including data privacy, potential algorithmic bias, and the responsible use of AI-generated content.

Data Collection and Evaluation

The evaluation approach was designed to identify participants' understanding of AI-assisted research instrument development and their ability to apply the concepts introduced during the training. The activity emphasized observation of participant engagement, discussion, and practical exercises.

The evaluation focused on the following aspects:

1. Participants' understanding of the role of AI in research methodology.
2. Participants' ability to formulate research questions and questionnaire items with AI assistance.
3. Participants' ability to identify the relevance and clarity of AI-generated questions.
4. Participants' understanding of validity, reliability, and ethical considerations.
5. Participants' confidence in integrating AI into their research activities.

The available activity description does not specify the use of pre-tests, post-tests, structured questionnaires, or statistical analysis. Therefore, the methodology does not claim numerical improvements in participant knowledge or research competencies.

Data Analysis

The training activity was analyzed descriptively based on the implementation of the learning process, participant engagement, and the practical application of AI-assisted research instrument development. The analysis emphasized the relevance of the training materials, the usefulness of AI tools in supporting research tasks, and the importance of human oversight in evaluating AI-generated outputs.

The evaluation of the training focused on identifying the potential contribution of AI-assisted techniques to research capacity building. Particular attention was given to participants' understanding of the relationship between AI technology and established research methodology.

Ethical Considerations

Ethical considerations were incorporated into the training materials and learning activities. Participants were introduced to the importance of protecting research data, maintaining confidentiality, and using AI responsibly. The training also emphasized that AI-generated research instruments require critical evaluation and should not be adopted without appropriate methodological review (Rustan et al., 2025).

The use of AI was presented as a supportive process that requires human judgment, theoretical understanding, and validation. This approach was intended to promote responsible research practices and maintain the integrity of the research process.

RESULTS AND DISCUSSION

Improvement in Participants' Understanding of AI-Assisted Research

The community engagement program conducted through ICMA on February 15, 2025, introduced participants to the use of Artificial Intelligence (AI) in research instrument development. The training emphasized that AI can support researchers in designing questionnaires, interview guidelines, observation sheets, and other research instruments. Participants were introduced to the basic concepts of AI, Generative AI, Natural Language Processing (NLP), and Machine Learning (ML), as well as their potential applications in the research process.

The learning activities helped participants understand that AI is not a substitute for researchers' methodological judgment. Instead, AI functions as an assisting technology that can accelerate the preparation of research instruments and support the identification of relevant indicators, variables, and question items. This understanding was important because research instrument development requires not only technical skills but also a clear understanding of research objectives, theoretical concepts, and the characteristics of respondents.

The discussion during the training also highlighted the importance of providing clear instructions when using AI tools. Participants learned that the quality of AI-generated outputs depends greatly on the quality of the prompts, the clarity of the research objectives, and the completeness of the information provided to the system (Sudarmanto et al., 2025). Therefore, researchers need to formulate structured prompts that explain the research topic, variables, indicators, target respondents, and expected type of instrument.

Application of Generative AI in Research Instrument Development

One of the main results of the program was the introduction of Generative AI as a practical tool for preparing research instruments. Generative AI can assist researchers in producing initial drafts of questionnaire items, interview questions, and observation indicators. This process may reduce the time required for the early stages of instrument development and provide researchers with alternative formulations of questions.

Participants were encouraged to use AI-generated questions as preliminary materials rather than as final instruments. Each item still needs to be reviewed based on its relevance to the research objectives, clarity of language, suitability for the respondents, and consistency with the selected theory (Renaldo et al., 2022). The training also emphasized that questions generated by AI may contain ambiguity, unnecessary repetition, leading statements, or concepts that are not appropriate for the research context.

The use of Generative AI was particularly relevant for researchers who experience difficulties in translating theoretical variables into measurable indicators. AI can provide examples of operational definitions and possible question items. Nevertheless, researchers must ensure that the proposed indicators are consistent with the conceptual framework and do not introduce variables that are unrelated to the research problem.

Understanding of Validity, Reliability, and Research Quality

The program also strengthened participants' awareness of the importance of validity and reliability in research instrument development. Participants were introduced to content validity, construct validity, face validity, test-retest reliability, and internal consistency. These concepts were discussed as essential procedures for ensuring that an instrument measures the intended concept accurately and consistently.

The training emphasized that AI-generated instruments cannot automatically be considered valid or reliable. AI may support the preparation and revision of instrument items, but the assessment of research quality must still involve researchers, experts, and, where appropriate, respondents. Expert review is necessary to determine whether the items adequately represent the research construct. Pilot testing is also important for identifying unclear questions, response difficulties, and potential weaknesses in the instrument.

The discussion further showed that researchers need to evaluate the wording and structure of each item. Questions should avoid double-barreled statements, overly technical terminology, emotionally biased wording, and assumptions that may not apply to all respondents. These considerations are necessary to reduce measurement errors and improve the quality of the data collected.

Awareness of Ethical Issues and Potential Bias

Another important result of the program was the increased awareness of ethical issues related to the use of AI in research. Participants were introduced to several potential risks, including privacy violations, the use of confidential information, algorithmic bias, inaccurate outputs, and excessive dependence on AI-generated content.

The training explained that researchers should not enter sensitive personal information, confidential institutional documents, or identifiable respondent data into AI platforms without appropriate safeguards.

Researchers are also responsible for checking whether AI-generated content reflects cultural, social, linguistic, or demographic biases. An instrument that appears technically well-structured may still be inappropriate if it disadvantages certain groups of respondents (Junaedi, Sofyanto, et al., 2025).

Human oversight was therefore presented as a central principle of responsible AI use. Researchers must verify the accuracy of AI-generated information, revise the language according to the local context, and ensure that respondents are treated fairly. Ethical considerations should be integrated into every stage of the research process, from instrument design to data collection, analysis, and reporting.

Discussion

The Role of AI in Strengthening Research Capacity

The results indicate that AI-assisted research instrument development has the potential to strengthen research capacity, particularly among researchers who need practical support in designing instruments. AI can provide rapid suggestions, alternative question formulations, and structured drafts. These functions may help researchers focus more attention on conceptual development, methodological decisions, and data interpretation.

However, the use of AI also creates a need for stronger methodological literacy. Researchers who rely on AI without understanding research design may produce instruments that are attractive in form but weak in theoretical and empirical foundations. Therefore, AI training should not be delivered as a purely technical activity. It should be integrated with research methodology, variable operationalization, measurement theory, validity, reliability, and research ethics (Delyana Rahmawany Pulungan et al., 2025).

The findings also suggest that the most appropriate approach is human-centered AI use. In this approach, AI supports repetitive and exploratory tasks, while researchers retain responsibility for theoretical reasoning, contextual adaptation, ethical judgment, and final decision-making. This balance is important to ensure that technological efficiency does not reduce the quality and integrity of research.

The program further demonstrated the importance of practice-based learning. Participants need opportunities to formulate prompts, generate sample questions, review AI outputs, revise instrument items, and discuss possible methodological weaknesses. Practical exercises can help participants move beyond conceptual understanding and develop the ability to use AI critically and responsibly.

Implications for Future Community Engagement Programs

The results provide several implications for future community engagement activities (Renaldo, Sudarno, et al., 2023). First, similar programs should include hands-on exercises using real or simulated research topics. Participants can be asked to develop research objectives, identify variables, create indicators, generate questionnaire items, and conduct a basic review of the resulting instrument.

Second, future programs should provide a structured checklist for evaluating AI-generated instruments. The checklist may include relevance to research objectives, theoretical consistency, clarity of wording, absence of bias, respondent suitability, validity considerations, reliability considerations, and ethical compliance (Junaedi, Hestia, et al., 2025).

Third, future training should introduce more advanced applications, such as NLP for analyzing open-ended responses, ML for identifying patterns in data, AI-supported coding, and data visualization. These topics should be introduced gradually according to participants' research competencies and technological readiness.

Finally, continued mentoring is recommended. A single training session can introduce important concepts, but sustained assistance is needed to ensure that participants can apply AI tools independently in their research projects. Follow-up consultations, instrument-review sessions, and collaborative research clinics may improve the long-term impact of the program.

CONCLUSION

Conclusion

The community engagement program conducted through ICMA on February 15, 2025, demonstrated the potential of Artificial Intelligence (AI) to support research instrument development. Through the training, participants were introduced to the use of Generative AI, Natural Language Processing, and Machine Learning in preparing questionnaires, interview guidelines, observation instruments, and other research tools.

The program emphasized that AI can improve the efficiency of the initial instrument-development process by providing ideas, alternative question formulations, operational definitions, and structured drafts.

However, AI-generated instruments still require critical review, theoretical alignment, expert evaluation, pilot testing, and ethical consideration.

The main conclusion is that AI should be positioned as a supporting technology rather than a replacement for researchers. The effective use of AI requires a combination of technological competence, research-methodology knowledge, critical thinking, and ethical responsibility. A human-centered approach is therefore essential to ensure that AI-assisted research instruments remain valid, reliable, relevant, and appropriate for the research context.

Implications

Practical Implications

The program provides practical benefits for researchers, lecturers, students, and research practitioners. AI can be used to accelerate the preparation of research instruments, identify possible indicators, improve the clarity of question items, and generate alternative formats for questionnaires and interviews.

The training also encourages researchers to develop a more systematic instrument-development process. Researchers can use AI during the drafting stage, while maintaining human control during the review, validation, revision, and finalization stages.

Methodological Implications

The findings highlight the importance of combining AI technology with established research methodology. AI-generated questions should always be evaluated based on research objectives, theoretical constructs, operational definitions, validity, reliability, and respondent characteristics.

The use of AI also requires researchers to improve their prompt-writing skills. Clear and detailed prompts can help generate more relevant outputs, but prompt quality alone cannot guarantee methodological accuracy. Researchers must remain responsible for assessing and validating the final instrument.

Educational and Institutional Implications

Higher education institutions and research organizations can integrate AI-assisted research instrument development into research-methodology courses, research clinics, workshops, and community engagement programs. Institutions should also provide guidance on responsible AI use, data privacy, academic integrity, and the protection of research participants.

The program suggests that AI literacy should be developed alongside research literacy. Researchers need to understand not only how to operate AI tools but also when the tools are appropriate, what risks they create, and how their outputs should be evaluated.

Limitations

This community engagement program has several limitations. First, the activity was conducted within a limited training context and focused primarily on introducing the potential use of AI in research instrument development. Therefore, the results may not represent the experiences of all researchers or research institutions.

Second, the available activity description does not provide detailed quantitative evaluation data, such as the number of participants, pre-test and post-test scores, participant satisfaction scores, or measured changes in research competence. Consequently, the effectiveness of the program cannot be expressed through statistical improvement indicators.

Third, the program focused mainly on the development of research instruments. It did not comprehensively evaluate the quality of research data collected through AI-assisted instruments or the long-term impact of AI use on research productivity and publication outcomes.

Fourth, AI tools and their capabilities continue to change rapidly. The examples and practices introduced during the training may require periodic updating to remain relevant to technological developments.

Finally, the use of AI may produce inaccurate, biased, or contextually inappropriate outputs. Although these risks were discussed, a single training activity may not be sufficient to develop advanced skills in detecting and correcting all possible AI-related errors.

Recommendations

Several recommendations can be proposed based on the program. First, future training should include more practical exercises using real research topics. Participants should be guided to formulate research objectives, identify variables, develop indicators, generate instrument items, and revise AI-generated outputs.

Second, training materials should provide a clear evaluation checklist for AI-assisted research instruments. The checklist should cover theoretical relevance, clarity, consistency, respondent suitability, cultural appropriateness, potential bias, validity, reliability, and ethical compliance.

Third, participants should be encouraged to use AI as a drafting and brainstorming tool rather than copying its outputs directly. Every AI-generated item should be reviewed and adapted by the researcher before being used in actual data collection.

Fourth, institutions should develop basic guidelines or standard operating procedures for responsible AI use in research. These guidelines should address privacy protection, confidential information, transparency, academic integrity, attribution, and human oversight.

Fifth, follow-up mentoring should be provided after the training. Research clinics, consultation sessions, peer review, and instrument-validation workshops can help participants apply the knowledge gained during the program.

Finally, future community engagement activities should involve collaboration among researchers, methodological experts, AI practitioners, and institutional ethics committees. Such collaboration can support a more comprehensive and responsible approach to AI-assisted research.

Future Research

Future research should investigate the effectiveness of AI-assisted research instrument development using a more systematic evaluation design. Quantitative studies may compare participants' knowledge, confidence, instrument-development skills, and research productivity before and after AI-focused training.

Further research should also compare instruments developed manually with instruments developed through AI assistance. The comparison may examine development time, item quality, content validity, construct validity, reliability, readability, and respondent comprehension.

Another important research direction is the investigation of AI bias in research instruments. Future studies may examine whether AI-generated questions produce cultural, linguistic, gender-related, age-related, or socioeconomic bias. This issue is particularly important when instruments are used across different regions, communities, and demographic groups.

Future studies may also explore the application of AI in more advanced research activities, including open-ended response analysis, automated coding, qualitative data categorization, predictive analysis, and research-data visualization. These applications should be evaluated not only in terms of efficiency but also in terms of accuracy, transparency, and ethical acceptability.

Longitudinal research is also recommended to examine the long-term effects of AI-assisted training on researchers' methodological competence, research output, publication quality, and institutional research capacity. In addition, future research could develop an integrated framework for human-centered AI-assisted research instrument development that combines technological tools, research methodology, validity and reliability procedures, and ethical standards.

Overall, future research should focus on ensuring that AI adoption in research contributes not only to faster instrument development but also to higher-quality, more inclusive, transparent, and ethically responsible research.

REFERENCES

Delyana Rahmawany Pulungan, Susantriana Dewi, Niken Widyastuti, Muthmainnah, & Nicholas Renaldo. (2025). Implementasi Work-Life Balance dalam Meningkatkan Kinerja Karyawan Milenial. *El-Mal: Jurnal Kajian Ekonomi & Bisnis Islam*, *6*(4). https://doi.org/10.47467/elmal.v6i4.7621

Guetterman, T. C., James, T. G., & DeJonckheere, M. (2026). Ethical considerations for the use of artificial intelligence in qualitative research: Questions for researchers, ethics boards, and reviewers. *Methods in Psychology*, *15*, 100266. https://doi.org/10.1016/J.METIP.2026.100266

Junaedi, A. T., Hestia, N., Suhardjo, Angelica, J., Renaldo, N., Tanjung, A. R., Putri, N. Y., Hutahuruk, M. B., Yusnidar, & Agusta, M. A. (2025). Promotion, Influencer Marketing, and Online Customer Review on Purchase Decisions in Shopee E-Commerce (A Case Study on The Community in Pekanbaru). *Procuratio: Jurnal Ilmiah Manajemen*, *13*(1), 97–108. http://ejournal.pelitaindonesia.ac.id/ojs32/index.php/PROCURATIO/index

Junaedi, A. T., Sofyanto, S., Renaldo, N., Suhardjo, S., Suharti, S., Suyono, S., Hutahuruk, M. B., & Haristan, M. (2025). THE INFLUENCE OF PERSONAL SELLING, DISTRIBUTION AND PROMOTION CHANNELS ON CONSUMER BUYING INTEREST IN MULIA TILE CERAMIC PRODUCTS AT PT SURYA ASIA ABADI PEKANBARU. *Kurs : Jurnal Akuntansi, Kewirausahaan Dan Bisnis*, *10*(1), 97. https://doi.org/10.35145/kurs.v10i1.5121

Madanchian, M., & Taherdoost, H. (2025). The impact of artificial intelligence on research efficiency. *Results in Engineering*, *26*, 104743. https://doi.org/10.1016/J.RINENG.2025.104743

Renaldo, N., Sudarno, Andi, Veronica, K., & Hutahuruk, M. B. (2023). Sales Volatility, Operating Cash Flow Volatility, Debt, and Firm Size on Future Earnings Persistence. *The Accounting Journal of Binaniaga*, *8*(01), 27–38. https://doi.org/10.33062/ajb.v8i01.19

Renaldo, N., Suharti, Suyono, & Suhardjo. (2022). *Manajemen Laba Teori dan Pembuktian* (T. Chandra & Priyono, Eds.). CV. Literasi Nusantara Abadi.

Renaldo, N., Suyono, Andi, Putri, N. Y., & Cecilia. (2023). How Business Intelligence, Intellectual Capital, and Company Performance Increase Company Value? Leverage as Moderation. *Journal of Applied Business and Technology*, *4*(1), 93–99. https://doi.org/https://doi.org/10.35145/jabt.v4i1.123

Rustan, F. R., Kalsum, T. U., Susanti, W., Junaedi, A. T., & Renaldo, N. (2025). *Teknik Penulisan Karya Ilmiah* (A. I. Sastra, Ed.). Yayasan Tri Edukasi Ilmiah.

Sudarmanto, E., Puspitasari, R., Septi, I., Renaldo, N., & Octasylva, A. R. P. (2025). Bagaimana Hubungan Budaya Korupsi dengan Kegagalan Sistem Pendidikan? *RIGGS: Journal of Artificial Intelligence and Digital Business*, *4*(1), 27–32. https://doi.org/10.31004/riggs.v4i1.366

Suhardjo, S., Renaldo, N., Sevendy, T., Yladbla, D., Udab, R. N., & Ukanahseil, N. (2023). Accounting Skills, Digital Literacy, and Human Literacy on Work Readiness of Prospective Accountants in Digital Technology Disruption Era. *Reflection: Education and Pedagogical Insights*, *1*(3), 106–115. http://firstcierapublisher.com/index.php/reflection/article/view/48

Suyono, Suhardjo, Renaldo, N., Sudarno, & Sari, S. F. (2021). Faktor-faktor yang mempengaruhi Corporate Social Responsibility dan Nilai Perusahaan. *Procuratio: Jurnal Ilmiah Manajemen*, *9*(1), 88–100.

Xu, Z., Wang, Y., & Qian, Y. (2025). The design and application of in-depth interviews in primary care research. *Chinese General Practice Journal*, *2*(2), 100062. https://doi.org/10.1016/J.CGPJ.2025.100062