

DRAFT

2022-2027



UP NISMED

Research and Extension Agenda

INTRODUCTION

To support its goal of raising the quality of science and mathematics education at the basic and teacher education levels, the University of the Philippines National Institute for Science and Mathematics Education Development (UP NISMED) crafted its *Research and Extension (R&E) Agenda for 2022-2027*. The R&E agenda is based on UP NISMED's mandate to do research, develop curriculum materials, and implement professional development programs and activities that can help improve the teaching and learning of science and mathematics in the country. Specifically, the R&E Agenda is aligned with the following missions of the Institute:

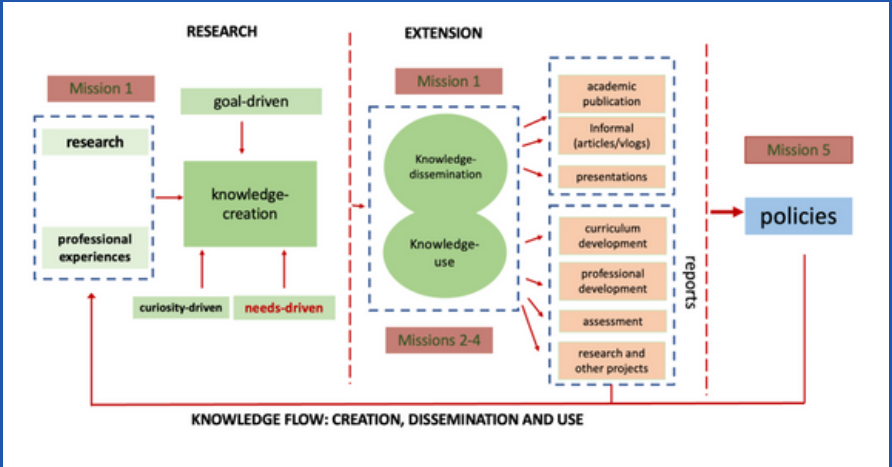
- Conduct research in science and mathematics education;
- Develop and disseminate research-based science and mathematics curriculum materials;
- Develop and implement innovative and research-informed programs for teachers and teacher educators in science and mathematics;
- Develop and implement emerging programs that will promote science and mathematics literacy among the citizenry; and
- Provide research-based inputs to policy formulation in science and mathematics education.

From these missions, the following core themes were crafted:

- Knowledge creation
- Knowledge dissemination
- Knowledge use
- Blue sky initiatives
- Research-based policy formulation

This R&E Agenda describes each of the five core themes. It also enumerates the priority areas under each core theme which the Institute shall focus its efforts and initiatives on in the next five years.

Research and Extension Agenda Framework 2022-2027



The framework illustrates the relationship between the two major mandates of UP NISMED— research and extension, with the five core themes of the agenda that are in line with the five missions of the Institute. Knowledge creation in UP NISMED may be a product of scientific research or obtained professional experiences. It is that part of research that is separated by the vertical broken line. The other remaining four themes cover the extension mandate of the Institute. UP NISMED’s works that are goal-driven and/or curiosity-driven are referred to as the *blue sky initiatives*. Knowledge dissemination on the other hand, refers to results of research works that should be communicated to the public either through academic publications, articles or blogs, or presentations. The research results must also be used in NISMED’S core functions: curriculum development, teacher training, assessment, research, and others. This is referred to as *knowledge use*. The framework also indicates that *knowledge use* could be the object of research itself. Critical to these functions are reports that will serve as bases for *policy-formulation*.

Mission 1: Conduct research in science and mathematics education

Core Theme: Knowledge Creation

Refers to the process of evaluating the stages of additional knowledge in terms of the assessment of competencies in STEM education, curriculum development in distance education, sustainability of professional development, bridging research to practice, understanding the current problems, and moral development in science and mathematics (S&M) education.

Theme 1: Assessment of competencies in STEM education

Description: Development and validation of various assessments in Science, Technology, Engineering, Mathematics, and integrated STEM such as readiness, learning loss and gain, and skills (21st century and future skills) that will inform policies in teaching and learning. It also includes an analysis of learning progression on STEM in science and mathematics K to 12 curricula

Priority Areas:

- readiness in science
- large scale assessment
- scientific and mathematical literacy
- skills possessed by K to 12 STEM learners and teachers
- 21st century skills in STEM education
- assessment and reporting of complex skills
- computational thinking study

Theme 2: Curriculum development in distance education

Description: Research that aims to investigate the challenges in science and mathematics teaching and how it can be improved in the context of distance education

Priority Areas:

- lesson study
- learning progression
- books in science and mathematics education

Theme 3: Sustainability of innovative professional development

Description: Research on emerging technologies (e.g., platforms, microlearning) and approaches (lesson study, LAC, PLC) and how these positively impact science and mathematics instruction

Subtheme: Pedagogy

Priority Areas:

- language as a resource in teaching and learning science and mathematics
- assessment of the quality of mathematics instruction (QMI)
- best practices and processes of sustainable intervention program for improving QMI
- meta-analysis of post-training support for teachers

Subtheme: Technology integration

Priority areas:

- models of community engagements
- sense of community of STEM teachers
- teacher competency in using social media
- effective audio visual materials for STEM teachers
- needs-based assessment on the use of different platforms in teaching and learning STEM
- gaming and storytelling as an instructional strategy

Theme 4: STEM learning ecosystem

Description: STEM education opportunities from radical social and technological breakthroughs

Priority Areas:

- STEM Education for Sustainable Development
- climate change
- sustainable production
- STEM identify and careers
- STEM for workforce readiness and development
- TVET
- culture and arts in STEM
- positive STEM education (socioemotional learning)

Theme 5: Diversity, inclusion, and equity in STEM education

Description: Research on local/Filipino scientific and mathematical literacy including the disadvantaged and marginalized actors in the STEM education ecosystem

Priority Areas:

- Ethnoscience/Ethnomathematics or culturally-connected STEM education
- indigenous knowledge, and scientific and mathematical literacy
- students with special education needs (SEN), gifted students, students with physical disabilities, out-of-school youth (OSY), and children in conflict with the law (CICL)
- geographically isolated and disadvantaged areas (GIDA) (e.g., last mile schools, children displaced by conflict)

Theme 6: Bridging research and practice

Description: Refers to understanding the process of transferring knowledge to various levels in science and mathematics education (i.e., student, teacher, administrators)

Priority Areas:

- big data for policy
- research
- computational thinking in teaching STEM

Theme 7: Current problems in science and mathematics education

Priority Area:

- historical research (science and mathematics education during the pandemic)

Theme 8: Values and moral development in science and mathematics education

Mission 2: Develop and disseminate research-based science and mathematics curriculum materials

Core Theme: Knowledge Dissemination

Providing equal access to S&M curriculum materials to address gaps in the teaching and learning process and research-based publications in the field of assessment

Theme 1: Equal access to various research-based S&M curriculum materials

Description: Refers to approaches on capitalizing on emerging educational technology (e.g., augmented reality, virtual reality, 3D printing, adaptive learning algorithms, asynchronous and microlearning, live streaming, social learning, learning games, and simulations)

Priority Areas:

- development of short videos/podcasts
- assessment of the quality of mathematics instructions (QMI) - the quality of the content and the quality of its teaching
- best practices and processes of sustainable intervention program for improving QMI
- comparative study of platforms used in microlearning
- models of community engagements

Theme 2: Bridging gaps to improve teaching and learning

Description: Bridging gaps to improve teaching and learning through the use of various platforms (print, nonprint, NISMED TV, Go Teacher Go!) supported by findings from recent local and international research papers

Priority Areas:

- initiatives to address least learned topics (e.g., Lewis symbols and structures, Molecular Geometry)
- baseline information on the current practices in Learning Action Cells

- design and implementation of a LAC model
- development of LAC evaluation/monitoring instruments
- impact of intervention
- data analysis of the Southeast Asia Primary Learning Metrics (SEA-PLM) regarding the issue of language in S&M education
- communicating science and mathematics (e.g., interpreting graphs, charts)

Theme 3: Publication of research papers in S&M education focusing on assessment

Description: Release and distribute research-based assessment materials with acceptable psychometric properties either under the classical or advanced measurement models (e.g., IRT, CDM).

Priority Areas:

- publication of assessment book aligned with international assessment (e.g., PISA, TIMSS)
- data analysis of large-scale assessment (e.g., PISA, TIMSS)
- partnerships or collaborations with other agencies and other institutions for research initiatives and publication
- capacity-building of UP NISMED staff to bolster the publication of research papers in high indexed journals (including theses and dissertations)
- revival of UP NISMED online journal

Mission 3:

Develop and implement innovative and research-informed programs for teachers and teacher educators in science and mathematics

Core Theme: Knowledge Use

Theme 1: STEM-focused professional development (PD) programs

Description: Provision of STEM PD programs for preservice and in-service teachers that promote development of critical STEM literacy and use innovative approaches that provide hands-on experiences such as teaching science through inquiry and teaching mathematics through problem solving.

Delivery modes: Remote; in-person; short-term course; microlearning; lesson study

Priority Areas:

- teachers' content knowledge and pedagogical skills in inquiry/lesson planning through PD programs
- specialized PD programs for small schools
- specialized PD programs for indigenous peoples
- use of 3D models in instruction and assessment

Theme 2: Lesson study

Description: Lesson study as a PD model that may be incorporated in learning action cells and adapted to the context of Filipino classroom teachers

Priority Area:

- Lesson study in STEM education

Theme 3: Supporting a learning culture through professional learning communities

Description: Provision of a platform for teacher support and continued professional development growth

Priority Areas:

- teachers' best practices through online platforms/radio
- teacher competency in using social media

Theme 4: Assessment as a tool to promote critical STEM literacy

Description: Provision of PD programs focused on the development of assessment tasks that promote critical STEM literacy

Priority Area:

- development of assessment tasks that promote critical STEM literacy

Theme 5: Inclusive and equitable access to STEM education

Description: Provision of innovative PD programs that are context-appropriate

Priority Areas:

- PD programs for last mile schools
- PD programs for indigenous peoples
- PD programs for small schools

Mission 4:

Develop and implement emerging programs that will promote science and mathematics literacy among the citizenry

Core Theme: Blue sky initiatives

Blue sky initiatives are exploratory, flexible, innovative, and curiosity-driven research and programs. This implies research into new and emerging fields in science and mathematics education brought about by technological and social innovations.

Theme 1: Emerging trends in science and mathematics educational research

Description: Research on emerging trends in science and mathematics educational research to inform teaching and learning

Priority Areas:

- data science in education: learning analytics, educational data mining, machine learning
- metrolytics and psychometrics in education
- cognitive science: usable knowledge of neuroscience in learning
- emerging EdTech: augmented reality and 3D printing

Theme 2: Teaching and learning with emerging technologies and breakthrough innovations

Description: Research on the role of emerging technologies and breakthrough innovations in learning and teaching, and processes of learning about and through these technologies

Priority Area:

- emerging EdTech: augmented reality and 3D printing
- 4D printing
- internet of things (IoT)
- augmented and virtual reality
- artificial intelligence
- metaverse
- machine learning

Theme 3: Advancing scientific literacy, mathematical literacy, and new literacies in life and society

Description: Development of teaching and learning materials, and public service initiatives that promote scientific, mathematical, statistical, and new forms of literacy made possible by digital technology developments using innovative approaches grounded on respect for local and diverse knowledge, culture, beliefs, and traditions

Priority Areas:

- indigenous knowledge, and scientific and mathematical literacy
- computational thinking
- coding in education
- disciplinary literacy
- microcontroller-based set-ups in teaching science
- public lectures and open labs

Mission 5:

Provide research-based inputs to policy formulation in science and mathematics education

Core Theme: Research-based policy formulation

Using the findings of research on various priority areas to inform policy in science and mathematics education in collaboration with partner government institutions

Theme: Recommendation of research findings for inputs to policy formulation in science and mathematics education

Description: Refers to organizing various learning events (e.g., conferences, fora, professional development, public lectures) where the information generated from research, monitoring, and evaluation in STEM education are reflected upon and intentionally used to continuously improve the quality of STEM education in the Philippines.

Engaging partner government agencies (e.g., Department of Education, Department of Science and Technology-Science Education Institute) in formulating policies in STEM education through involving them with the Institute's research projects.

Priority Areas:

- assessment in STEM education
- professional development
- STEM curriculum materials
- STEM concepts
- Filipino STEM teacher identity
- remote learning
- emerging educational technologies
- BERA themes (teaching and learning, child protection, human resource development, governance, inclusive education, gender development)



University of the Philippines
National Institute for Science and Mathematics Education Development
E. Quirino Avenue, UP Campus, Diliman
Quezon City, Philippines