UP NISMED Research and Extension Agenda 2023-2027

Advancing STEM Education

University of the Philippines
NATIONAL INSTITUTE FOR SCIENCE AND MATHEMATICS EDUCATION DEVELOPMENT

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Preface

The crafting of the Research and Extension (R&E) Agenda of the University of the Philippines National Institute for Science and Mathematics Education Development (UP NISMED) commenced with an environmental scanning of the state of science, technology, engineering, and mathematics (STEM) education in the country and in Southeast Asia. The Institute convened educators and STEM researchers from national and international institutions to share their experiences, perspectives, and current research related to STEM education.

The UP Charter and UP NISMED's mandate, philosophy, and strategic plan for 2020 to 2024 were revisited to serve as bases for the crafting of this Agenda. Documents from various government agencies and international organizations were also reviewed to obtain a detailed picture of the current STEM education landscape. All these formed part of the basis for the Institute's planning meeting, in which each academic group convened to set their own research and extension priorities. An equally vital part in the crafting of this R&E Agenda was the consultation with key stakeholders through roundtable discussions. In each of the two roundtables, the consolidated agenda from the different academic groups of the Institute was presented. The first roundtable was attended by former NISMED directors and deputy directors while the second roundtable was attended by various stakeholders from the different offices of the

Department of Education (DepEd), from private local and international organizations, and from other educational institutions.

The roundtable discussions generated rich inputs that helped address pertinent issues and contributed to the improvement and finalization of the Agenda.

UP NISMED's R&E Agenda is intended to set the tone and direction of the Institute's research and extension initiatives in the next five years. It aims to provide directions in the creation of new knowledge and in building the Institute's capacity to address challenges in STEM education. It also aims to guide the Institute as it utilizes this new knowledge to develop extension programs that will help improve the teaching and learning of STEM. Other organizations may also use this Agenda as a reference, when they plan and conduct their research and extension activities related to STEM education. Furthermore, through this Agenda, the Institute invites partnerships with other organizations to collaborate in research and extension activities that will contribute to the shared goal of advancing STEM education in the country.

In view of the evolving STEM education landscape, UP NISMED considers this R&E Agenda as dynamic. It needs to be revisited and updated based on any shift in its programs and on the latest trends in the local and international settings.

The Research and Extension Agenda Framework

With the goal of improving the state of STEM education in the country, the Research and Extension Agenda of UP NISMED is guided by the mission of the Institute to:

- Conduct STEM education research;
- Develop and disseminate research-based STEM resources;
- Implement research-informed teacher professional development programs;
- Promote scientific literacy and mathematical literacy; and
- Provide research-based inputs to policies.

The Agenda is founded on the Institute's core values—*Excellence, Integrity,* and *Social Responsibility*.

Based on this, the Institute will vigorously pursue research and extension initiatives that are aligned with the following mission-driven core themes:

- Bridging gaps to improve teaching and learning;
- Supporting teaching practice; and
- Advancing STEM education with emerging technologies.

To enhance and strengthen STEM education, the research and extension activities that the Institute aims to pursue are those that bridge the gaps between theory and practice and address the challenges in science and mathematics teaching. Developing and implementing research-informed programs and projects to upskill and retool STEM educators, and producing research-based teaching and learning resources are ways to address these gaps.
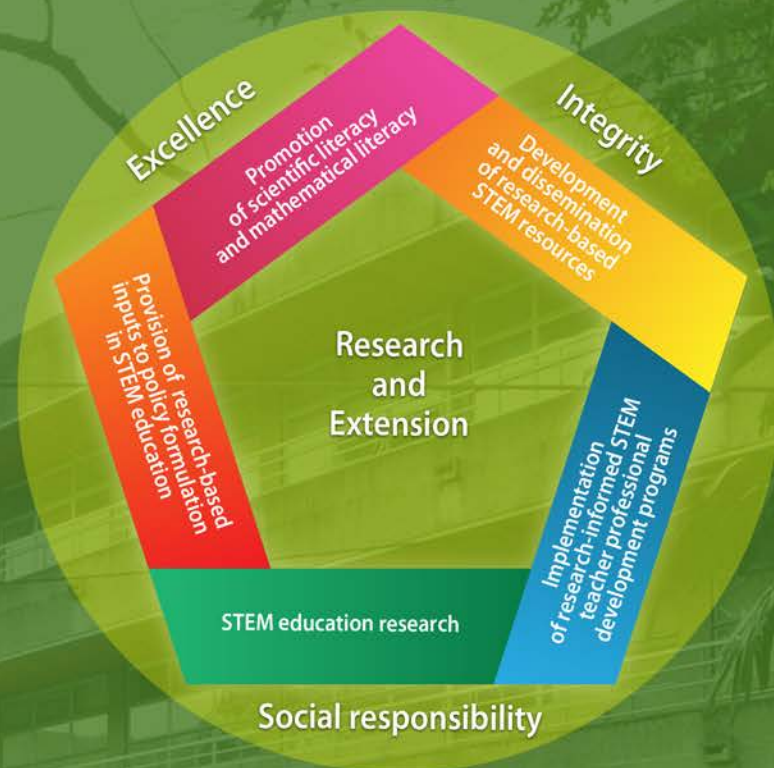

Figure 1. The UP NISMED Research and Extension Agenda Framework.

The research and extension activities of the Institute also include provision of teacher support to improve teaching practice. Teacher support may be through capacity building as well as provision of teaching and learning resources and post-training support activities to reinforce teacher learning. Moreover, UP NISMED's research and extension activities also take into consideration the potential of emerging technologies in enhancing STEM education. Thus, experimenting on how to take advantage of these new technologies and breakthrough innovations in promoting STEM education that transcends traditional classrooms shall be one of the priorities of the Institute.

As a research and extension unit, it will continue to produce new knowledge and disseminate and utilize them as the Institute develops and implements research and extension work in the following strands in the next five years.

The Research and Extension Agenda Framework

- Advancing scientific literacy, mathematical literacy, and new literacies in life and society
- Assessment as a tool to promote STEM literacy
- Inclusive and equitable access to various research-based STEM curriculum materials

Bridging gaps to improve teaching and learning

- Assessment of competencies in STEM education
- Continuing and innovative professional development
- Lesson study
- Inclusive and equitable access to professional development in STEM education
- Learning culture in professional learning communities

Supporting teaching practice

- Emerging trends in STEM education research
- Innovative STEM pedagogies
- Promoting STEM literacy through breakthrough technologies
- STEM education futures

Advancing STEM education with emerging technologies

Figure 2. UP NISMED Research and Extension Agenda core themes and strands.

The knowledge creation in the Institute, is a product of its research initiatives and may be influenced by scientific research or obtained through professional experiences of the staff. It is also goal-driven, curiosity-driven, and needs-driven and may lead to blue sky research and extension initiatives of the Institute. *Knowledge dissemination and use* on the other hand, results from research works that may be communicated to the public either through academic publications, articles or blogs, or presentations. The research results must also be used in UP NISMED'S core functions: curriculum development, teacher training, research, and assessment. Moreover, knowledge use could be the object of research itself. Critical to these functions are reports and findings that will serve *as bases for policy-formulation* related to STEM education. This aspect of knowledge use may focus on the following:

- drafting legislations on key result areas;
- establishing facilities; and
- developing handbooks, frameworks, models, and curriculum standards.
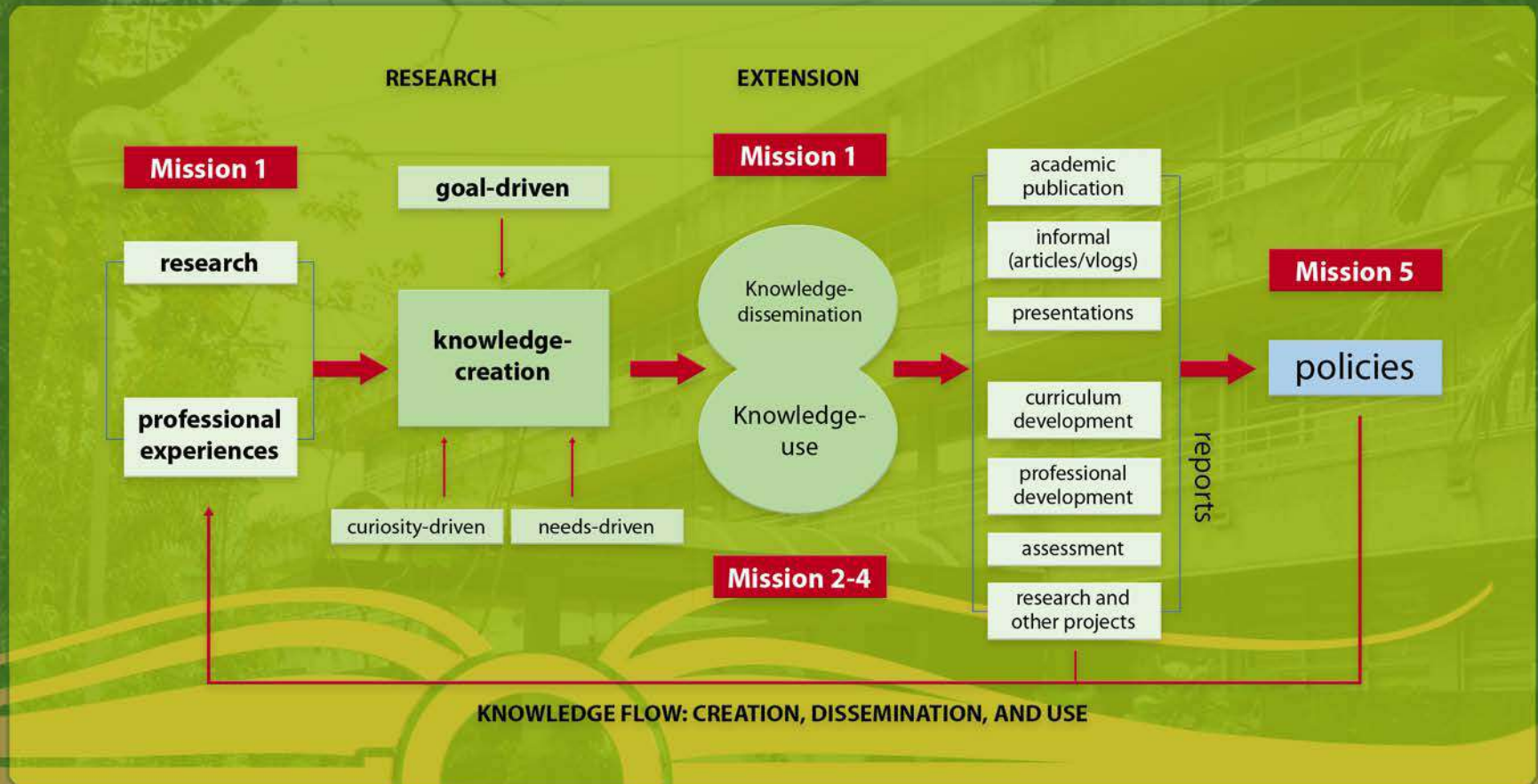
The Research and Extension Agenda Framework

RESEARCH   EXTENSION

Mission 1   Mission 1   academic publication

goal-driven

research   knowledge-creation   Knowledge-dissemination   informal (articles/vlogs)   Mission 5

presentations

professional experiences   Knowledge-use   curriculum development   policies

curiosity-driven   needs-driven   professional development

reports

Mission 2-4   assessment

research and other projects

KNOWLEDGE FLOW: CREATION, DISSEMINATION, AND USE

Figure 3. The knowledge flow process in UP NISMED's research and extension initiatives.

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Core Theme 1: Bridging gaps to improve teaching and learning

Strand	Priority Areas
Advancing scientific literacy, mathematical literacy, and new literacies in life and society This strand refers to research and extension initiatives that promote scientific and mathematical literacy as well as other new forms of literacy through digital technology developments using innovative approaches, which are diverse yet inclusive of culture, beliefs, and traditions.	• 21st Century skills in STEM education • Computational thinking • Data literacy • Digital fluency • Disciplinary literacy • Scientific and mathematical literacy • STEM proficiency
Assessment as a tool to promote STEM literacy This strand refers to research and extension initiatives that involve development, validation of various assessments in STEM such as readiness, learning loss and gain, and skills that will inform teaching and learning that promotes STEM literacy.	• Assessment of STEM readiness • Analysis of large-scale assessments • Assessment of scientific and mathematical literacy
Inclusive and equitable access to various research-based STEM curriculum materials This strand refers to research and extension initiatives that involve the use of approaches that capitalize on technology to widen reach and make materials more inclusive and equitable in the STEM education ecosystem. This also refers to STEM learning and how it can be improved in the context of diverse modalities.	• Culturally-connected STEM education (e.g., ethnoscience, ethnomathematics) • Innovative STEM curriculum materials (e.g., videos/podcasts, digital stories, apps, micro-learning) • Flexible STEM learning • Learner-centered STEM platforms • STEM for disadvantaged learners (e.g., geographically isolated, out-of-school youth, last mile schools, children displaced by conflict) • STEM for students with special education needs (SEN) (e.g., gifted students, visually impaired students) • Gender-responsive STEM education

Core Theme 2: Supporting teaching practice

Strand	Priority Areas
Assessment of competencies in STEM education This strand refers to research and extension initiatives that involve development and validation of tools that may be used to assess competencies in STEM.	• Assessment tasks that promote critical STEM literacy • Skills possessed by K to 12 STEM learners and teachers
Continuing and innovative professional development This strand refers to research and extension initiatives that involve provision of STEM professional development programs for preservice and in-service teachers that promote the development of STEM literacy, use of innovative approaches, and engaging experiences (e.g., teaching science through inquiry, teaching mathematics through problem solving), and use of emerging technologies and how these positively impact teaching and learning. These initiatives may be delivered through in-person, remote, or employ the HyFlex teaching and learning mode.	• Best practices and processes of sustainable intervention programs • Communicating science and mathematics • Data science for educators and educational researchers • Instructional leaders and teachers among the indigenous communities • Knowledge for teaching • Learning progression • Lifelong learning of STEM teachers
Lesson Study This strand refers to research and extension initiatives that involve lesson study as a professional development model and may be incorporated in learning action cells and adapted to the context of Filipino classroom teachers.	• Developing STEM education competencies through Lesson Study • Learning Action Cell (LAC) • Lesson Study in distance education • Lesson Study in preservice teacher education • Sustainability of Lesson Study
Inclusive and equitable access to professional development in STEM education This strand refers to research and extension initiatives that involve use of different modalities in delivering professional development programs in STEM education that are inclusive and accessible.	• Inclusive and accessible professional development • Micro-credentialing • Microlearning • Trainings in distance learning modalities
Learning culture in professional learning communities This strand refers to research and extension initiatives that involve provision of a platform for teacher support and continued professional growth.	• Models of community engagement • Teachers' best practices through online platforms/radio • Teacher's competency in using social media • Teacher's sense of community

Core Theme 3: Advancing STEM education with emerging technologies

Strand	Priority Areas
Emerging trends in STEM education research This strand refers to research initiatives on emerging trends in STEM education to inform teaching and learning.	• Educational data mining • Learning analytics • Machine learning
Innovative STEM pedagogies This strand refers to research and extension initiatives that involve use of innovative pedagogical approaches to create meaningful classroom activities and enriching experiences.	• Cultures of thinking • Blended Learning Models • Inquiry Approach • Integrating culture and arts in STEM • Issue-based approach • Positive STEM education • Project and project-based learning • Teaching through problem solving
Promoting STEM literacy through breakthrough technologies This strand refers to research and extension intiatives that use emerging technologies and breakthrough innovations in the learning and teaching processes to advance STEM literacy.	• AI-assisted assessment • 3D printing and materials science • Coding • Internet of Things
STEM education futures This strand refers to research and extension initiatives that involve STEM education opportunities from social and technological breakthroughs.	• Futures thinking • Space science • STEM education for sustainable development (e.g., climate change, food security, responsible consumption production, smart agriculture) • STEM for workforce readiness and development (e.g., integration of STEM in technical-vocational education training (TVET))

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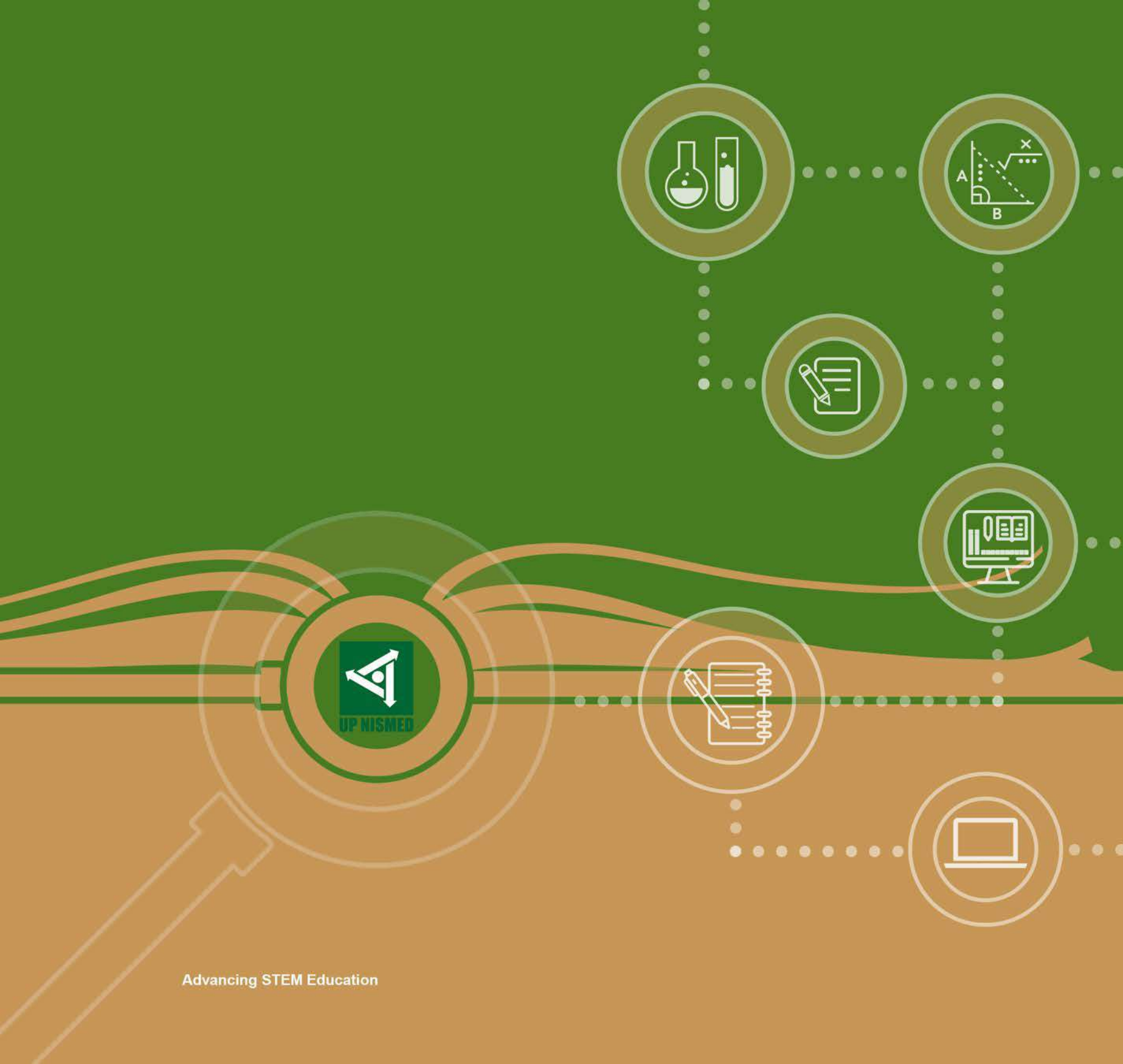
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