NAMA International Journal of Education and Development, 1:2 (DEC 2024) 245-270
ISSN: 2948-3638

The Impact of ROOTS on 21st Century Teaching and Learning: An Analysis of the Performance of Schools in Indonesia, Tanzania and Kyrgyzstan in 2021 and 2022

Tunku Badariah Tunku Ahmad,[1] Faresh Mohd Sahari & Puteri Nur Yasmin Mohamad Sahari

ABSTRACT

This paper describes the impact of NAMA's teacher training intervention, called ROOTS, on teachers' implementation of 21st century teaching and learning in three countries, i.e., Indonesia, Tanzania and Kyrgyzstan. A total number of 558 lessons in 63 schools in the three countries were observed using a classroom observation tool. The impact of ROOTS on 21st century teaching and learning was examined by looking at the presence or prevalence of nine indicators, namely student engagement, clear learning outcomes and success criteria, collaborative learning, thinking and problem solving, real-life connections in lessons, checking student understanding (AfL), differentiation, self- and peer assessment, and use of technology, media and resources. The data were first factor analyzed to establish the nine domains as appropriate indicators of 21st century teaching and learning. Descriptive statistics were employed to summarize the sizes and patterns of impact across the indicators, while Cohen's d effect sizes (ES) were estimated to determine the practical importance of each impact. The results allow the report to conclude that NAMA's ROOTS professional development program has been effective in enhancing the instructional competencies of teachers in Indonesia, Tanzania, and Kyrgyzstan in the nine domains of 21st century teaching and learning, with the most substantial impact observed in Kyrgyz schools. Notable improvements were evident across the board, particularly in the areas of collaborative learning and real-life connections. These findings align with Kyrgyzstan's serious commitment to improving the quality of their education and advancing teachers' implementation of 21st century instructional practices. In contrast, Indonesia requires further intervention in teachers' use of technology, media, and resources, as well as thinking and problem-solving activities, formative assessment, and differentiation skills. Likewise, Tanzania would benefit greatly from further teacher training in technology integration, formative assessment, and differentiation.

Keywords: *21st Century Teaching and Learning, Performance of Schools, NAMA foundation*

1 Kulliyyah of Education, International Islamic University Malaysia, Kuala Lumpur, Malaysia
**Corresponding Author:* tbadariah@iium.edu.my

INTRODUCTION

21st Century Competencies: Its Importance in Today's Education

Much of today's talk and discussion about education and learning centers around fostering 21st century skills in students. The term "21st century skills" is used generically to refer to a set of core competencies that present-day students must have in order to thrive in the ever challenging modern world. The competencies include collaboration, communication, creativity, critical thinking (otherwise known as the 4Cs), digital literacy, and problem-solving (Berry, 2010; Rich, 2010). In the 21st century classroom, as opposed to the traditional classroom, learning becomes learner-centred and learner-driven. Teachers change the ways of working (i.e., emphasizing collaboration, communication and team work) and the ways of thinking (i.e., promoting problem-solving, critical thinking, creativity and reflective thought) and use a variety of tools (i.e., digital apps and Web 2.0 tools) to galvanize greater and more authentic student learning.

Powerful and meaningful learning of this nature demands highly competent and well-prepared teachers capable of implementing 21st century teaching and learning activities. But one might ask--what do these activities look like? The following classroom scenarios may be used to illustrate the idea:

Scenario 1 (Science class): Students work with a partner to read an article containing false information about the effects of sun exposure on the skin. The teacher poses questions like, *"How do you determine if the information given about sun exposure is correct?"* and *"What makes you believe or doubt the accuracy of this article?"* The skills involved in this learning activity are collaboration, reasoning and critical thinking, using evidence to refute arguments, and communicating ideas clearly and logically (adapted from Roque Ferreira *et al.,* 2020)

Scenario 2 (History class): Students work in a group of 5 to 6 to role-play the characters responsible for the outbreak of World War 2 in 1939. One student role plays the character of Adolf Hitler, another assumes the role of Joseph Stalin, a third student plays Benito Mussolini, so on and so forth. In producing the role play, students must create authentic dialogues containing the real historical facts. Apart from collaboration and communication, this learning activity requires students to be independent researchers of history and use their creativity and imagination to create the dialogues.

Scenario 3 (Language class): Students are given the task of writing a descriptive paragraph without adjectives. They must use their creativity and imagination in order to write such a paragraph. Once they are done, students exchange their work for a peer review process. They will read, edit and complete each other's work with the correct adjectives, and then provide feedback to their peers on the quality of the paragraphs written (adapted from the JCBN

International School website, 2024). This learning activity requires students to be creative and imaginative writers and also providers of good feedback to their peers (i.e., peer assessment).

Scenario 4 (Environmental science class): Students study the state of a local river destroyed by waste and pollution. They then write a report to profile the extent of the pollution and suggest a viable restoration programme to save the river. This learning activity requires students to do real field work to solve a real environmental problem. The skills involved are problem analysis and problem solving.

All the classroom scenarios described depart from traditional learning. The tasks demand deep student engagement in that students become active participants in the process of constructing new knowledge and understanding.

The 21st Century Teaching and Learning Framework

Student engagement is an important feature or indicator of 21st century education and whether or not teachers can ensure that it takes place in the classroom depends on their innovative use of pedagogy. In the 21st century education framework, learning must result in meaningful and active student engagement with the content. Teachers can bring this about by implementing activities that lead to collaborative learning (such as the jigsaw method, brainstorming and buzz groups), critical thinking, creativity and problem solving. To develop the latter three skills, teachers may employ inquiry. Hence, teachers' continuous professional development in teaching strategies is key to their teaching success.

Apart from these four characteristics (i.e., student engagement, critical thinking, creativity and problem solving), several other features define the 21st century classroom. In such a classroom, for instance, learning is not superficial but rather, it is driven by authentic knowledge application to solve real-world problems. Learning tasks are not mundane; instead, they are laced with real-world issues and have real-life connections. In other words, using authentic material, teachers help students to see the practicality and relevance of their classroom learning. Teachers also guide students' learning by making lesson outcomes and success criteria explicit to them and students work both independently and in collaborative groups to achieve them.

The 21st century teacher knows that students have varying levels of ability and that not everyone learns the same way. Each student is unique and has his/her own style and preferences for learning. Therefore, effective 21st century teaching requires the teacher to be adept at differentiation (i.e., tailoring instruction to meet each student's unique needs and foster their individual growth). Teachers' skill in differentiating instruction is critical to the implementation of 21st century education that includes all students in the learning process. To ensure that no student is left behind, teachers need to employ several strategies known to assist classroom learning, for example, implementing formative assessment in everyday lessons (i.e., regularly checking students' understanding) and maximizing learning through input and feedback

from peer assessment. Incorporating peer assessment into teaching not only reduces teachers' workload but it also increases student engagement in the learning process. Students are also good providers of informative feedback on teaching effectiveness. To ensure that teachers have the skill to use peer assessment appropriately and optimally, an effective teacher training intervention needs to be put in place.

In 21st century classrooms, teachers will find the use of digital technology helpful in making content more concrete, visible and comprehensible. They can use relevant apps and digital platforms in many different ways to achieve myriad instructional objectives. For instance, in 21st century science teaching, an example of meaningful technology usage is employing interactive multimedia (Yulyani *et al.,* 2023), dynamic visualizations (Rolfes *et al.,* 2020) and video resources (Higgins *et al.,* 2018) to teach STEM concepts like motion (physics) and genetics (biology). Teachers of Islamic Education can also revolutionize their teaching by incorporating virtual reality glasses, hologram and 8D sound technologies to teach about the Prophet Muhammad (peace be upon him) and his life, as well as to convey Islamic teachings in a manner that instills deep understanding and appeals to the senses (Basiron & Zulkifli, 2023). In such a classroom, technology tools are used to assist students' discovery and construction of new knowledge. Instead of being merely passive recipients of information, students are empowered by the tools to become active users of new information as they engage in the processing of it. The indicators of 21st century education (that includes teaching, learning and assessment) examined in the report, based on the preceding discussion, are visually summarized in Figure 1 below:

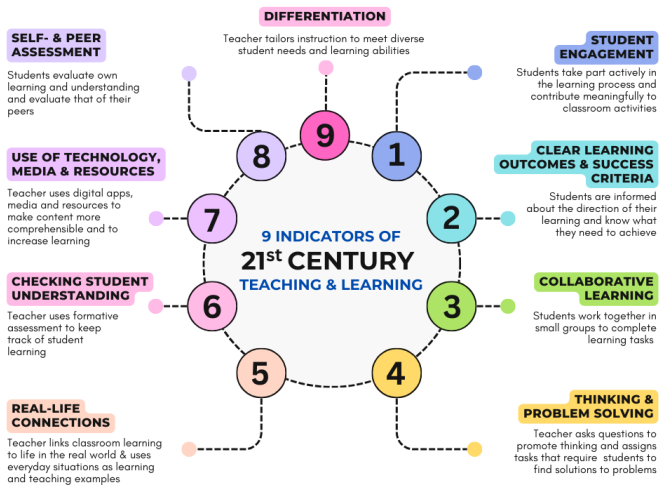

Figure 1: Nine Indicators of 21st Century Teaching and Learning Assessed in the Report

The ROOTS Project

Understanding the critical importance of 21st century teaching to sustainable student learning, NAMA Foundation implemented an intervention programme called ROOTS (i.e., the acronym for Roadmap of Outstanding Educators) in 2017. It started with eight countries, seven of which were Indonesia, Lebanon, Yemen, Tanzania, India, Kyrgyzstan, and Malaysia. The intervention aimed to transform teachers in these countries into able and contemporary educators by equipping them with skills in assessment and 21st century teaching, among others. The use of these skills was expected to result in greater student learning and engagement. To meet this goal, teachers were systematically trained in learner-centred strategies, basic learning design and gamification, as well as in coaching and mentoring skills and facilitation strategies.

ROOTS is a capacity building initiative for teachers in which they are shown how to transform classroom learning into actual performance. By implementing ROOTS, NAMA believes it can increase teacher effectiveness and students' learning efficiency, both inside and outside the classroom. The project was rolled out in three waves (phases) between 2017 and 2019 involving 161 schools, 1,854 teachers and 55,620 students (NAMA Foundation, 2020). Currently, its 2023-2019 Strategic Planning focuses on Indonesia, Kyrgyzstan and Tanzania involving 63 schools and more than 500 teachers.

LITERATURE REVIEW

This review discusses what we know so far about 21st century education (i.e., teaching and learning implementation) in Indonesia, Tanzania and Kyrgyzstan. The review is limited to website information and articles retrievable from the Internet through Google search and Google Scholar.

Indonesia

Like many other nations in South-East Asia and around the globe, Indonesian education is largely rooted in traditional teaching and learning. Hence, few studies have had the interest to look into the implementation of 21st century teaching in Indonesian schools. One recent effort by Daflizar and Alfian (2023) in the field of English Language Teaching (ELT) came to the conclusion that "the integration of 21st century skills into EFL classrooms was…..disappointing" (p. 911). Teachers rarely used 21st century strategies and only resorted to them "a few times a semester" or "between 1 and 3 times per month" (p. 911). The element most often incorporated into student learning was critical thinking (M = 2.90 indicating low frequency), followed by collaboration (M = 2.87) and technology usage (M = 2.87). Teachers placed the least emphasis on making local and global connections to lessons, which is an important component of 21st century learning.

Indonesian teachers struggle to incorporate critical thinking into classroom instruction as they lack a proper understanding of what it is, generally using terminology from Bloom's taxonomy in defining CT (Defianty & Wilson, 2022). As discovered in a recent study, teachers tend to erroneously define it as "criticizing things," "deep thinking" and "student empowerment." Only a handful of studies have attempted to address 21st century teaching in Indonesian schools. For example, Khoiri *et al.* (2021) examined the presence of 21st century components (4Cs) in student learning in urban, middle, and rural schools. They found that the levels of collaboration, critical thinking and creativity in student learning were acceptable, but all schools lacked activities that promoted communication skills. The schools also needed to improve in regard to teachers' use of technology.

In their analysis of 21st century skills taught in English classes at an Indonesian vocational secondary school, Ratama *et al.* (2021) observed numerous instances in which the 4Cs were implemented. However, teachers still faced challenges in teaching critical thinking, collaboration and communication skills, but did fairly well in developing creativity. In another study, teachers were observed to use a variety of strategies to develop the skills of collaborating, communicating, creativity and critical thinking in students, but lacked the ability to use technology effectively (Rezandy *et al.,* 2020). In cases where the 21st century skills were weakly implemented, teachers attributed the shortcomings to time constraints, insufficient funds and facilities, low student motivation, and difficulties in integrating the various competencies (Rezandy *et al.,* 2020; Shabrina & Astuti, 2022). The review suggests that Indonesian teachers are generally diligent in their efforts to implement 21st century teaching despite their lack of skills and understanding of what it fully constitutes.

Tanzania

Part of Tanzania's early efforts toward 21st century education began in 2017 and 2018, where it implemented technology-enhanced teaching (one of the focus areas in 21st century education). The effort started with the teaching of STEM subjects (i.e., Science, Technology, English, and Math) in three primary schools where teachers of the schools were trained to use tablets, digital resources and new instructional strategies to deliver STEM content. The effort paid off as the responses from the teachers and schools were very positive. An impact survey showed that 84% of the teachers were either "extremely satisfied" (42%) or "very satisfied" (42%) with the use of tablets in the classroom. In 2022, further to this effort, the Ministry of Education distributed 300,000 tablets to schools to boost students' access to digital content and resources (UNICEF Tanzania, 2024). The project succeeded in increasing student learning, thereby showing the impact of technology-enhanced teaching in varying degrees of effectiveness (Komba & Shukia, 2023).

In May 2024, together with Airtel and UNICEF as partners, Tanzania launched the Smart WASOMI initiative. The project provides free Internet connectivity to schools in the country, making digital content accessible to learners in urban and rural areas. It is part of a greater educational agenda to

develop an evidence-based digital learning strategy to support Tanzania's determined strive towards 21st century education (UNICEF Tanzania, 2024).

Tanzania has gone through a number of educational reforms, the latest one being to implement a 21st century curriculum (Senjiro & Lupeja, 2023) for primary and secondary schools. According to Kumba and Shukia (2023), the basic education curriculum in Tanzania has a clear emphasis on developing problem-solving, collaboration, creativity, and critical thinking skills in students and a clear goal of 21st century education. Teachers are given pedagogical training to teach these skills, yet what is implemented in school by most teachers is still very much "fact-oriented and based on knowledge transfer. [Additionally] the development of skills and how to apply this knowledge to every day situation is largely neglected" (Digital Education Africa Network Report-Tanzania, 2020, p. 4). Teachers lack the skills of 21st century teaching, resulting in "a variation between the enacted and the intended curriculum" (Kumba & Shukia, 2023, p. 8). In their analysis of how the 21st century curriculum was implemented, Kumba and Shukia (2023) noted that critical thinking was given a greater emphasis than other skills, while collaboration, creativity and communication were pushed to the periphery.

Michael (2022) observed that teachers did not use instructional materials that could develop 21st century thinking skills (e.g., criticality of thought, analytical thinking and creativity) in students. Their use of materials was restricted to "textbooks, revision books, and resource books that were not enough to extend children's knowledge" (p. 100). These materials were reportedly inadequate in 21st century content. While digital technology could easily address this inadequacy, its use in the classroom was poor and limited. In addition, teachers' choice of instructional strategies--that included lectures, questions and answers, group discussions, oral presentations and problem-solving--did little to improve student thinking.

Meanwhile, Senjiro and Lupeja (2023b) pointed out that although formative assessment is a crucial element of 21st century education, how Tanzanian teachers were using it fell short of promoting the development of the 4Cs (i.e., collaboration, creativity, critical thinking and communication). Michael (2022) reported this same shortcoming earlier in her study. She wrote that teachers were more concerned with students' passing their important examinations than with developing student thinking. Teachers did not employ varied formative and summative assessment techniques, but constrained assessment to "weekly, monthly, mid-term tests, terminal examinations, annual examinations, and pre-mock examinations" (p. 102). These assessment methods could give little constructive feedback to galvanize further learning and higher-order thinking in students.

A recent study looking into Geography teaching in East Tanzania found teachers to lack an understanding of 21st century skills, i.e., what they might look like and how to develop them in students (Senjiro & Lupeja, 2023). This lack of knowledge severely limited teachers' ability to design and implement learning activities that would promote the skills. Teachers were clearly in need of a

professional development programme to develop their 21st century pedagogical skills.

21ST Century Teaching and Learning in Kyrgyzstan

Kyrgyz schools have similar trends of teaching and learning as their Indonesian counterparts where classroom instruction is largely traditional. In fact, the prevalence of 21st century teaching may even be less than that found in Indonesian schools. According to a comprehensive situational analysis of 20 public secondary schools across Kyrgyzstan (Dean *et al.,* 2021), involving 108 lessons in mathematics, the natural sciences, computer science and English, the teachers observed (n = 112) largely taught "teacher-centered, textbook-based" (p. iv) lessons that focused mostly on developing students' subject matter knowledge. The analysis further reveals "a dependence on the textbook for science teaching, learning and assessment" (p. iv). In the teaching of mathematics, the following remarks were written:

> They [Math teachers] are more confident in using traditional teacher-centered methods than the student-centered methods of enquiry and discussion. They feel least confident in incorporating ICT in their teaching and using formative assessment to facilitate student learning. In mathematics lessons, teachers generally demonstrate how to solve textbook problems on the board and have students use the same algorithm to solve similar problems. Teaching students to use higher order thinking skills to justify their answer and choice of method is much less exercised (Dean *et al.,* 2021, p. iv)

Based on the analysis, it appears that many key aspects of 21st century teaching and learning—such as inquiry-based learning, collaborative group discussions, technology integration, formative assessments, and fostering higher-order thinking—are largely missing from classroom instruction in Kyrgyzstan. The lack of these student-centred strategies limits students' ability to engage in critical thinking, problem-solving, and self-directed learning, which are core competencies in the 21st century education framework.

The same shortcomings were reiterated in a more recent report by KG Analytics (2022), which offered the following observations:

> The learning process is not restructured to develop competencies (that is, the development of abilities to independently apply knowledge, skills, and abilities in everyday life) as required by modern life and

> the State Educational Standard (2014). Learning in schools, as in the old days, is 87% based on reading, memorizing, and retelling, i.e., teachers give information and students memorize….Many of the subject standards required of teachers also do not focus on the development of competencies. The simple transfer of knowledge for the purpose of memorization is still the primary method of instruction. Consequently, in subject lessons, students engage in lower-order thinking activities much more often than higher-order thinking activities…..Little use is made of information and communication technology (ICT) for subject instruction...The number of computers available at schools is 1 computer per 61 students; many computers are obsolete and do not work.

KG Analytics (2022) emphasized how teaching and learning in Kyrgyz schools is still largely focused on memorization and knowledge retention, rather than fostering higher-order thinking, collaboration, or problem-solving skills. This limited approach to teaching will not help Kyrgyz students to develop critical 21st century competencies. Furthermore, the report pointed out that "in the Kyrgyz Republic, there is no system for assessing the achievements (as learning outcomes) of schoolchildren, [hence] the quality of education is not measured" (p. 9). These are very serious issues that demand immediate action by the Kyrgyz Ministry of Education. Meanwhile, they can be partially addressed through initiatives such as the ROOTs intervention.

OBJECTIVES AND SCOPE OF THE PAPER

The aim of this paper is to report on the impact of the ROOTS intervention programme on teachers' implementation of 21st century teaching and learning in three countries, i.e., Indonesia, Kyrgyzstan and Tanzania, following NAMA's 2023-2019 Strategic Planning roll-out. Specifically, it documents and profiles the teaching indicators and compares the changes in them after ROOTS. The profiling is done using a classroom observation rubric. Impact in this context is defined as changes that took place in teachers' instructional practices as a result of the ROOTS intervention. Changes are determined by examining the presence or absence of the indicators in the classrooms observed. Before profiling the indicators and comparing the changes, the 21st century teaching and learning data are first factor analyzed to ascertain that the items used to assess the indicators are valid and reliable.

METHODOLOGY

Participants

Sixty-three (N=63) schools were involved in this impact evaluation exercise examining the prevalence of 21st century teaching and learning indicators taken to represent the impact of the ROOTS teacher training programme. Some 38% of them were schools in Indonesia (n=28), 33.3% were Tanzanian schools (n=21), and the remaining 28.6% were Kyrgyz schools (n=18). All of them were Islamic learning institutions. The total number of lessons observed were 558--taught by more than 560 teachers from the 63 schools.

Sources of Data

Data on the prevalence of 21st century teaching and learning in the 63 Indonesian, Tanzanian and Kyrgyz schools--taken to represent the impact of ROOTS--were drawn from the classroom observations of 558 lessons. Of this number, 371 lessons were observed in 2021 (66%) and 188 in 2022 (34%) (Figure 2). Changes in them are taken to suggest the impact of ROOTS.

The lessons were taught by more than 560 different teachers in the 63 schools. In 2021, by country, Indonesia was observed for 204 lessons (36.5%), Tanzania for 192 lessons (34.3%), and Kyrgyzstan for 163 lessons (29.4%) (Figure 3).

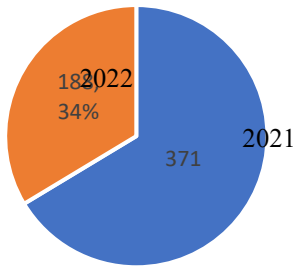

Figure 2: Lessons Observed by Year (N = 559)

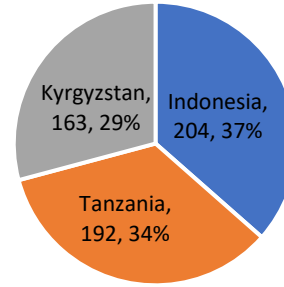

Figure 3: Lessons Observed by Country (N = 559)

The subjects observed were, among others, Mathematics (65 lessons), English Language (50 lessons), Physics (43 lessons), History (25 lessons), Chemistry (22 lessons) and Arabic Language (15 lessons), Krygyz and Russian Languages (10), Reading (2), and miscellaneous other subjects (326) (Figure 4). By grade level, the majority of the classes seen by the observers were middle school (70%), followed by high school (16%), upper primary (8%), lower primary (5%) and other (unspecified) levels (1%) (Figure 5).

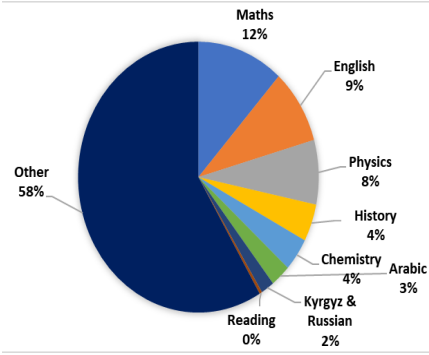

Figure 4: Lessons Observed by School Subject
(N = 559)

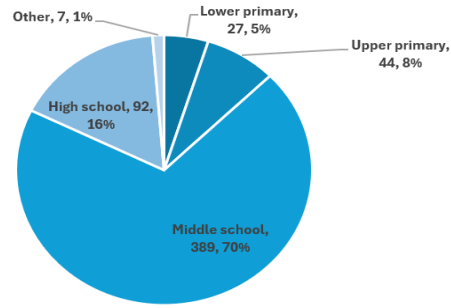

Figure 5: Lessons Observed by Grade Level
(N = 559)

Instruments

Two instruments were used, i.e., a lesson or classroom observation form and a set of rubrics. Both instruments were created by NAMA and were fully utilized in all lesson evaluations by the assessors or observers. The form had three parts to it: (1) lesson details (containing the names of the school, observer and teacher being observed; date and duration of the observation; subject, topic and class/grade level; lesson objectives; and student enrollment by gender); (2) five items on teaching and learning categorized under LST1 (i.e., the domain being *learning success* and the dimension being the *teacher* dimension); and (3) six other T&L indicators categorized under the LST2. The contents of the observation form are summarized in Table 1.

Part	Description	Item
1	Lesson Details	Names of school, teacher & observer; Date & duration of observation; Subject, topic and class/grade level; Lesson objectives; Student enrollment by gender
2	LST1	1) Asking questions to promote thinking & problem solving
		2) Giving opportunities for students to collaborate and work independently
		3) Linking student learning to real life experiences (applying what they learned)
		4) Integrating technology into the lesson/giving activities that require technology skills
		5) Displaying good understanding of the curriculum *(excluded)*

3	LST2	1)	Engaging learners through the use of various interactive tools or techniques *(excluded)*
		2)	Communicating clear learning objectives and success criteria to students
		3)	Embedding self/peer assessment in classroom routines
		4)	Checking for students understanding and giving useful feedback (AfL)
		5)	Differentiating lessons, content and activities
		6)	Establishing a positive classroom environment via mutual respect *(excluded)*

Note: LS = Learning Success (domain); T = Teacher (dimension); Afl = Assessment for Learning

Table 1: Content Summary of the Observation Form

Since the paper sought to report the impact of ROOTS on the implementation of 21st century education practices, item 5 under LST1 and items 1 and 6 under LST2 were excluded from the analysis as they were judged to be less of a 21st century teaching indicator based on the literature review.

The following rubrics were then used with the observation form to facilitate the assessment of 21st century teaching and learning indicators. The rubrics contained a 4-point rating scale and the accompanying descriptors for each indicator. A sample descriptor (for technology use by teachers) is shown in Table 2.

Table 2: Rubrics: Rating Scale and Descriptors for Teachers' Technology Use

Scale	Level	Descriptor
1	Limited Evidence	Uses no additional forms of resources beyond the textbook. No evidence of technology use.
2	Developing	Uses more than one type of media/resource, primarily just to engage students' interest. There is some use of technology.
3	Achieved Expectations	Uses more than one type of media/resource to promote learning & media literacy skills (e.g., uses more than one media to deliver lesson content). Technology use is encouraged.
4	Excelling	Purposeful use of more than one type of media/resource to help learners master the learning objectives (e.g., there's blended learning element). Use of technology is embedded.

Data Analysis

Before assessing the impact of ROOTS, the analysis first ran an exploratory factor analysis technique, i.e., Principal Axis Factoring (PAF) with Promax rotation, on the data to ascertain that the nine indicators used in the lesson observations did indeed measure a single construct, i.e., 21st century teaching and learning. To establish the results' interpretability and usability, eight PAF

measures were examined, namely (1) the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy (which should be between 0.8 and 1 to indicate adequate sampling); (2) Bartlett's test of sphericity (which must be statistically significant at $p < .05$); (3) the inter-item correlation matrix (which must show low or moderate correlations among the items or indicators); (4) communalities; (5) proportion of variance explained; (6) factor loadings; (7) eigenvalues (which must be greater than 1 for a factor to be retained); and finally (8) the scree plot and factor interpretability to decide the number of factors to be retained (in case there was more than the expected one factor measuring 21st-century teaching and learning).

The subsequent analyses involved the use of descriptive statistics and effect size estimations. Frequencies, percentages, means and standard deviations were used to describe and summarize the implementation of 21st century teaching and learning in the selected schools across the three countries. Charts, tables and graphs are used wherever necessary in this report to illustrate the changes in every indicator and to enhance the readability and utility of the results. Next, the effect sizes of the changes were estimated using Cohen's *d,* where $d = 0.2$ is considered small, $d = 0.5$ is medium, and $d = 0.8$ and above is large and of practical importance (Cohen, 1988).

RESULTS

Indicators of 21st Century Teaching and Learning: Factor Extraction Results

As expected, the PAF results support the presence of a single factor measuring a single construct, i.e., 21st century teaching and learning. The measures of sampling adequacy were well-satisfied, with a meritorious Kaiser-Meyer-Olkin (KMO) value of .89 and a statistically significant Bartlett's test of sphericity, $x^2(36) = 526.34$, $p = .001$. The nine indicators loaded into a single dimension representing 21st century teaching, in congruence with the scree plot that shows the presence of a single construct in the data (Figure 6):

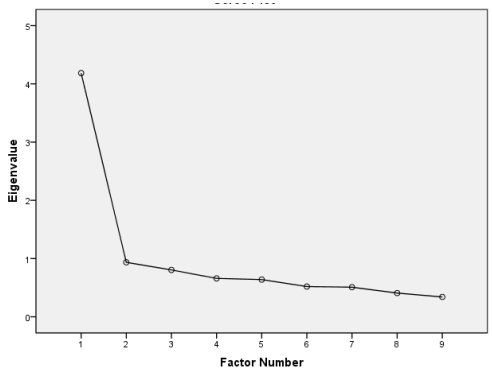

Figure 6: Scree Plot Suggesting a One-Factor Structure of the Data

The extracted factor with the nine indicators explains 40.2% of the variance in the 21st century teaching data with an eigenvalue of 4.19. The inter-item correlation matrix (Table 3) shows that the nine indicators are either weakly or moderately correlated with one another, supporting the idea that they do not constitute an identity matrix, as earlier indicated by the statistically significant Bartlett's test of sphericity.

Table 3: Inter-Item Correlation Matrix for the Nine 21st Century Teaching Indicators

INDICATOR	LST1_A	LST1_B	LST1_C	LST1_D	LST2_A	LST2_B	LST2_C	LST2_D	LST2_E
LST1_A	1.000								
LST1_B	.437	1.000							
LST1_C	.393	.325	1.000						
LST1_D	.198	.291	.232	1.000					
LST2_A	.389	.556	.370	.468	1.000				
LST2_B	.489	.383	.298	.263	.366	1.000			
LST2_C	.445	.423	.307	.262	.421	.406	1.000		
LST2_D	.580	.510	.457	.343	.463	.441	.508	1.000	
LST2_E	.364	.389	.252	.297	.395	.409	.481	.510	1.000

A further examination of the communalities and factor loadings shows the items to be an acceptable set of indicators for 21st century teaching and learning. Table 4 shows the items' communality values (COMM), factor loadings (FL), means (M) and standard deviations (SD), as well as the eigenvalue (EV), variance explained (VE) and Cronbach's alpha of the extracted factor. An alpha of .85 indicates that the nine items are reliable indicators of the 21st century teaching and learning construct.

Table 4: Properties of the Nine Indicators of 21st Century Teaching and Learning

Code	Indicator	COMM	FL	M	SD	EV	VE	Alpha
LST2_D	Teacher Checking Student Understanding (AfL)	.612	.782	1.76	.75	4.19	40.2%	.85
LST2_A	Student Engagement	.460	.678	2.31	.74			
LST1_B	Collaborative Learning	.447	.668	1.73	.77			
LST1_A	Thinking & Problem Solving	.446	.668	1.72	.71			
LST2_C	Self- & Peer Assessment	.428	.654	1.49	.67			
LST2_E	Differentiation	.382	.618	1.35	.59			
LST2_B	Learning Outcomes & Success Criteria	.367	.606	1.55	.67			
LST1_C	Real-Life Connections	.267	.517	1.77	.75			
LST1_D	Use of Technology, Media & Resources	.206	.454	1.75	.75			

Given the interpretability and reliability of the items and construct, the study proceeded with the descriptive analysis of the three countries' performances on the nine indicators.

Indonesia's Performance in 21st Century Teaching and Learning

For Indonesia, 132 lessons were observed in 2021 and 72 in 2022, resulting in a total number of 204 lessons. The country's performance on all nine indicators for both years is shown in Table 5.

The patterns indicate marked improvements in seven of the nine indicators, especially in four of them, namely collaborative learning (CL), real-life connections, AfL or checking student understanding, and thinking and problem solving. CL improved by 39 percentage points (or 575%) from the previous year in terms of achieving the expectations of ROOTS. In 2021, the prevalence of CL in Indonesian classrooms was recorded at just 6.8% but surged to 45.8% in 2022. Lessons that showed *limited evidence* of CL also dropped drastically by 48.5 percentage points. The second largest impact was seen in teachers' making real-life connections in their lessons, which increased by 28.1% in 2022, followed by the implementation of AfL (i.e., teachers' checking student understanding during instruction), which surged by 17.6 percentage points in the two-year span. The fourth indicator that showed a marked improvement was thinking and problem solving with a 15.6% increase from the previous year. Student engagement was not observed in 2021, but in 2022, 52.8% of the lessons observed had reportedly met the expectations of ROOTS. This was quite an impressive achievement by Indonesia. Furthermore, the country showed some evidence of excelling in the domains of collaborative learning, peer and self-assessment and AfL.

Table 5: Indonesia's Performance in 21st Century Teaching and Learning (2021-2022)

Indicator	Year	Performance Level				M	SD
		Limited	Developing	Achieved Expectations	Excelling		
		[1]	[2]	[3]	[4]		
Thinking & Problem Solving	2021	51 (38.6)	54 (40.9)	27 (20.5)	- -	1.82	.75
	2022	15 (20.8)	31 (43.1)	26 (36.1)	- -	2.15	.74
Collaborative Learning	2021	97 (73.5)	23 (17.4)	9 (6.8)	3 (2.3)	1.38	.72
	2022	18 (25.0)	19 (26.4)	33 (45.8)	2 (2.8)	2.26	.87
Real-Life Connections	2021	38 (28.8)	66 (50.0)	27 (20.5)	1 (0.8)	1.93	.72
	2022	8 (11.1)	29 (40.3)	35 (48.6)	- -	2.38	.68

Use of Technology, Media & Resources	2021	29 (22.0)	66 (50.0)	37 (28.0)	- -	2.06	.71
	2022	24 (33.3)	24 (33.3)	23 (31.9)	1 (1.4)	2.01	.85
Student Engagement	2021			*Not Observed*			
	2022	4 (5.6)	29 (40.3)	38 (52.8)	1 (1.4)	2.50	.63
Learning Outcomes & Success Criteria	2021	71 (54.2)	46 (35.1)	14 (10.7)	- -	1.56	.68
	2022	23 (35.4)	28 (43.1)	13 (20.0)	1 (1.5)	1.88	.78
Self- & Peer Assessment	2021	94 (71.2)	28 (21.2)	7 (5.3)	3 (2.3)	1.39	.69
	2022	31 (43.7)	29 (40.8)	10 (14.1)	1 (1.4)	1.73	.76
Teacher Checking Understanding (AFL)	2021	65 (49.2)	36 (27.3)	30 (22.7)	1 (0.8)	1.75	.83
	2022	11 (15.3)	31 (43.1)	29 (40.3)	1 (1.4)	2.28	.74
Differentiation	2021	86 (65.2)	35 (26.5)	11 (8.3)	- -	1.43	.64
	2022	35 (49.3)	24 (33.8)	12 (16.9)	- -	1.68	.75

Technology and media usage was low; less than one third of the lessons observed (31.9%) met the expectations, a small increase of just 3.9% from the previous year. Additionally, less than a 10% improvement was recorded in lessons meeting the expectations for learning outcomes and success criteria (9.3%), self- and peer assessment (8.8%) and differentiation (8.6%). This suggests that Indonesian teachers may need more training in these aspects of 21st century teaching.

A visual inspection of the indicator means gives us a clearer picture of the impact of ROOTS on Indonesian teachers' practices of 21st century teaching. The means shown in Figure 2 support the patterns seen in the descriptive results. The indicators with the most improvements were CL, AfL, real-life connections and thinking and problem-solving. In terms of mean scores, the use of technology, media and resources went down slightly. As technology usage is a critical feature of 21st century learning, NAMA needs to address this decline in its subsequent ROOTS intervention.

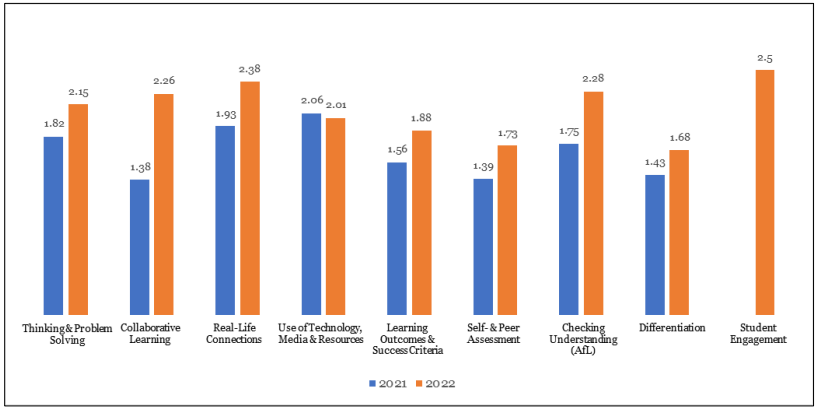

Figure 7: Indonesia's Performance in 21st Century Teaching and Learning by Mean Score

To summarize the impact of ROOTS on Indonesia, the country started off with "limited evidence" in seven of the indicators, ranging from a low of M = 1.38 (collaborative learning) to a high of M = 1.93 (real-life connections) in 2021. After ROOTS, its means in eight indicators crossed the threshold of 2.0, showing "developing evidence" or developing teacher competencies in these areas of 21st century teaching and learning. The exception is technology usage, which decreased slightly by 0.05 points in 2022.

Tanzania's Performance in 21st Century Teaching and Learning

Tanzania was observed for 192 lessons in total, 130 in 2021 and 62 in 2022. Tanzanian teachers' performance on all nine indicators of 21st century teaching for both years is shown in Table 6.

Tanzania showed a marked improvement of more than 10 percentage points in five domains, namely collaborative learning (22%), real-life connections (16.3%), learning outcomes and success criteria (15.6%), thinking and problem solving (13.8%), and AfL (11.5%). It showed some progress in technology and media usage (8.4%) and a minute improvement in differentiation (0.8%). However, Tanzania regressed in self- and peer assessment, where its performance dropped by 2.2 percentage points in 2022, while showing no evidence of excelling in any of the nine indicators of 21st century teaching and learning emphasized in the ROOTS project.

Teachers' use of technology, media and resources was mostly very limited in both years, i.e., 68.5% in 2021 and 63.9% in 2022, in addition to another important indicator which was lacking in the lessons observed, namely differentiation. Limited evidence of these two indicators was noted in more than 60% of the lessons observed.

Table 6: Tanzania's Performance in 21st Century Teaching and Learning (2021-2022)

Indicator	Year	Performance Level				M	SD
		Limited	Developing	Achieved Expectations	Excelling		
		[1]	[2]	[3]	[4]		
Thinking & Problem Solving	2021	82 (63.1)	45 (34.6)	3 (2.3)	- -	1.39	.54
	2022	18 (29)	34 (54.8)	10 (16.1)	- -	1.87	.67
Collaborative Learning	2021	68 (52.3)	57 (43.8)	5 (3.8)	- -	1.52	.57
	2022	5 (8.1)	41 (66.1)	16 (25.8)	- -	2.18	.56
Real-Life Connections	2021	84 (64.6)	42 (32.3)	4 (3.1)	- -	1.38	.55
	2022	24 (38.7)	26 (41.9)	12 (19.4)	- -	1.81	.74
Use of Technology, Media & Resources	2021	89 (68.5)	37 (28.5)	4 (3.1)	- -	1.35	.54
	2022	39 (63.9)	15 (24.6)	7 (11.5)	- -	1.48	.70
Student Engagement	2021			*Not Observed*			
	2022	17 (27.4)	36 (58.1)	9 (14.5)	- -	1.87	.64
Learning Outcomes & Success Criteria	2021	91 (70)	38 (29.2)	1 (0.8)	- -	1.31	.48
	2022	25 (41)	26 (42.6)	10 (16.4)	- -	1.75	.72
Self- & Peer Assessment	2021	92 (70.8)	33 (25.4)	5 (3.8)	- -	1.33	.55
	2022	40 (64.5)	21 (33.9)	1 (1.6)	- -	1.37	.52
Teacher Checking Understanding (AFL)	2021	71 (54.6)	53 (40.8)	6 (4.6)	- -	1.5	.59
	2022	22 (35.5)	30 (48.4)	10 (16.1)	- -	1.81	.70
Differentiation	2021	112 (86.2)	17 (13.1)	1 (0.8)	- -	1.15	.38
	2022	44 (71)	17 (27.4)	1 (1.6)	- -	1.31	.50

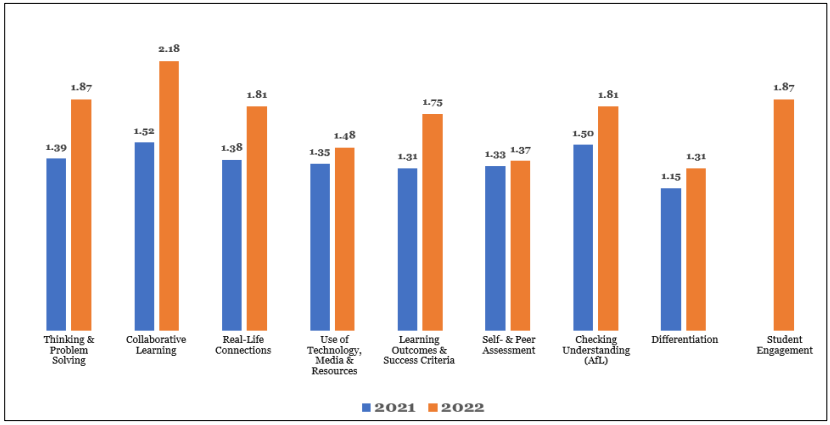

Figure 8: Tanzania's Performance in 21st Century Teaching and Learning by Mean Score

To summarize the impact of ROOTS on Tanzania, the country started off with "limited evidence" in almost all indicators, ranging from a low of M = 1.15 (differentiation) to a high of M = 1.52 (collaborative learning) in 2021. After ROOTS, its means in five indicators improved substantially (i.e., collaborative learning, thinking and problem solving, real-life connections, learning outcomes and AfL), with one of these indicators crossing the threshold of 2.0, showing "developing evidence" or developing teacher competencies (i.e., collaborative learning). Tanzania did not perform exceptionally well in two areas, namely technology usage and self- and peer assessment, both of which showed minimal improvements in 2022.

Kyrgyzstan's Performance in 21st Century Teaching and Learning

For Kyrgyzstan, a total of 162 lessons were observed, 108 in 2021 and 54 in 2022. The country's performance on all nine indicators for both years is shown in Table 7.

Kyrgyzstan performed well in all nine indicators of 21st century teaching, particularly in collaborative learning, where 50% of the lessons observed by assessors had met the expectations of ROOTS. Kyrgyz teachers' implementation of CL showed an increase of 44.5 percentage points from the previous year. Three other indicators also recorded marked improvements, namely AfL (with an increase of 40.8 percentage points), real-life connections (recording an increase of 36.1 percentage points) and thinking and problem solving (with a 31.5% increase).

Table 7: Kyrgyzstan's Performance in 21st-Century Teaching and Learning (2021-2022)

Indicator	Year	Performance Level				M	SD
		Limited	Developing	Achieved Expectations	Excelling		
		[1]	[2]	[3]	[4]		
Thinking & Problem Solving	2021	66 (60.6)	41 (37.6)	2 (1.8)	- -	1.41	.53
	2022	9 (16.7)	27 (50)	18 (33.3)	- -	2.17	.69
Collaborative Learning	2021	58 (53.2)	45 (41.3)	6 (5.5)	- -	1.52	.60
	2022	9 (16.7)	18 (33.3)	27 (50)	- -	2.33	.75
Real-Life Connections	2021	73 (67)	33 (30.3)	3 (2.8)	- -	1.36	.54
	2022	9 (16.7)	23 (42.6)	21 (38.9)	1 (1.9)	2.26	.76
Use of Technology, Media & Resources	2021	50 (45.9)	47 (43.1)	12 (11)	- -	1.65	.67
	2022	11 (20.4)	27 (50)	15 (27.8)	1 (1.9)	2.11	.74
Student Engagement	2021	*Not Observed*					
	2022	5 (9.3)	17 (31.5)	28 (51.9)	4 (7.4)	2.57	.77
Learning Outcomes & Success Criteria	2021	72 (66.1)	36 (33)	1 (0.9)	- -	1.35	.50
	2022	18 (33.3)	23 (42.6)	12 (22.2)	1 (1.9)	1.93	.80
Self- & Peer Assessment	2021	68 (62.4)	37 (33.9)	4 (3.7)	- -	1.41	.57
	2022	13 (24.1)	25 (46.3)	15 (27.8)	1 (1.9)	2.07	.77
	2021	66	41	2	-	1.41	.53

		(60.6)	(37.6)	(1.8)	-		
Teacher Checking Understanding (AFL)	2022	4	27	23	-	2.35	.62
		(7.4)	(50)	(42.6)	-		
Differentiation	2021	99	10	-	-	1.09	.29
		(90.8)	(9.2)	-	-		
	2022	20	28	8	-	1.78	.69
		(37)	(48.1)	(14.9)	-		

Student engagement (SE) was not observed in 2021 but in 2022, SE was reported in 51.9% of the lessons observed. Kyrgyzstan demonstrated moderate achievements in self- and peer assessment (with a 24.1% increase in lessons meeting the criteria of 21st century teaching set by NAMA), learning outcomes and success criteria (with a 21.3% increase), technology and media usage (16.8% increase), and differentiation (with a 14.9% increase). A visual presentation of the means (Figure 9) shows marked improvements in all nine indicators. The least impact or achievement demonstrated by Kyrgyzstan is in the domain of technology and media usage. It may also need further ROOTS intervention in differentiation and learning outcomes and success criteria.
To summarize the impact of ROOTS on Kyrgyzstan, the country started off with "limited evidence" in eight indicators, ranging from a low of M = 1.09 (differentiation) to a high of M = 1.65 (technology usage) in 2021. After

ROOTS, its means in seven indicators crossed the threshold of 2.0, showing "developing evidence" or developing teacher competencies in these areas of 21st century teaching and learning. The exceptions are "learning outcomes and success criteria" with a 2022 mean of 1.93 and "differentiation" with a 2022 mean of 1.78. These two areas will need more work in future ROOTS interventions.

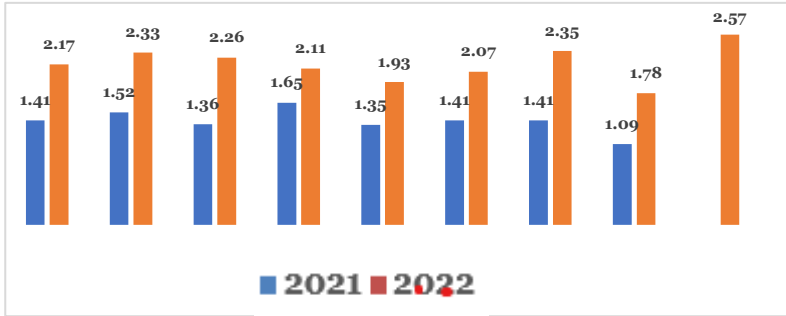

Figure 9: Kyrgyzstan's Performance in 21st Century Teaching and Learning by Mean Score

Effect Size Estimations of Impact by Country and Indicator

In this section, by using means and standard deviations, we computed the impact of ROOTS on each 21st century teaching indicator and tabulate it by country. The resulting effect sizes (ES) of the changes in every indicator, in Cohen's *d,* along with what they mean, are listed in Table 8.

Based on the analysis of the effect sizes, the ROOTS intervention had the most significant impact on Kyrgyz schools, where the effect sizes were predominantly large and meaningful. The only area of 21st century teaching that showed a moderate impact was teachers' use of technology, media, and resources. The greatest impact of ROOTS in Kyrgyzstan was on teachers' assessment for learning practices (d = 1.63), followed by real-life connections (d = 1.37), differentiation (d = 1.30), and thinking and problem-solving (d = 1.24).

In comparison, Tanzania and Indonesia exhibited similar performances, both showing a large impact in collaborative learning and small to moderate impacts across the other seven indicators. Tanzania had the advantage of not regressing in any domain, while Indonesia experienced a slight regression or decrease in teachers' technology and media use (d = 0.06).

Table 8: Effect Size Estimations of the Impact of ROOTS by Country and Indicator

	Indicator	Indonesia		Tanzania		Kyrgyzstan	
		d	ES	*d*	ES	*d*	ES
1)	Thinking & Problem Solving	0.44	small	0.79	moderate	1.24	large
2)	Collaborative Learning	1.10	large	1.17	large	1.19	large
3)	Real-Life Connections	0.64	moderate	0.66	moderate	1.37	large
4)	Use of Technology, Media & Resources	-0.06*	negligible	0.21	small	0.65	moderate
5)	Learning Outcomes & Success Criteria	0.44	small	0.72	moderate	0.87	large

6)	Self- & Peer Assessment	0.47	small	0.07	negligible	0.97	large
7)	Checking Understanding (AfL)	0.67	moderate	0.48	small	1.63	large
8)	Differentiation	0.36	small	0.36	small	1.30	large
9)	Student Engagement	n/a		n/a		n/a	

Notes: *d* = Cohen's *d;* ES = *Effect Size; * Indonesia decreased in technology use*

Conclusion

The results indicate that NAMA's ROOTS professional development program has effectively enhanced the instructional competencies of teachers in Indonesia, Tanzania, and Kyrgyzstan in the selected domains of 21st century teaching and learning, with the most substantial impact observed in Kyrgyz schools. Notable improvements were evident across the board, particularly in the areas of collaborative learning and real-life connections. These findings align with Kyrgyzstan's serious commitment to improving the quality of their education and advancing teachers' implementation of 21st century instructional practices. In contrast, Indonesia requires additional support in areas such as the use of technology, media, and resources, as well as thinking and problem-solving activities, formative assessment, and differentiation skills. Similarly, Tanzania would greatly benefit from further teacher training in technology integration, formative assessment, and differentiation.

The results should help NAMA refine and enhance its professional development programs by identifying specific areas where teachers in the three countries will need further support. The insights should inform NAMA in terms of designing and developing more targeted training focusing on critical domains like technology and media use, assessment for learning and differentiation to address the identified gaps in teachers' competencies. NAMA should also look into the impressive performance of Kyrgyz schools and leverage their successful outcomes to identify the strengths in their implementation, foster collaboration among teachers in the three nations, and enhance teacher practices in Indonesia and Tanzania. By acting on these insights, NAMA can strengthen its impact on teacher development and improve educational outcomes in these regions.

REFERENCES

Basiron, M. F. B., & Zulkifli, H. (2023). Digital virtual reality teaching aids in Islamic education. *International Journal of Academic Research in Progressive Education and Development, 12*(4), 1024-1218. http://dx.doi.org/10.6007/IJARPED/v12-i4/19263

Berry, B. (Oct 11, 2010). How do you define 21st-century learning? *Education Week.* Retrieved from https://www.edweek.org/teaching-learning/how-do-you-define-21st-century-learning/2010/10

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Lawrence Erlbaum Associates.

Daflizar & Alfian. (2023). Nurturing students' 21st-century skills in the classroom: Indonesian EFL teachers' perceived practices. *Issues in Educational Research, 33*(3), 897-919. http://www.iier.org.au/iier33/daflizar.pdf

Dean, B. L., Hung, W., Papieva, J., & Muibshoev, A. (2021). *Education for the 21st century in Kyrgyzstan: Current realities and roadmap for systemic reform.* UCA: Education Improvement Programme.

Defianty, M., & Wilson, K. (2023). Critical thinking in ELT: Indonesian teachers' understanding and practice ten years down the track. *Indonesian Journal of English Education, 9*(1), 120-139. DOI: 10.15408/ijee.v9i1.26673

Higgins, J., Moeed, A., & Eden, R. (2018). Video as a mediating artefact of science learning: Cogenerated views of what helps students learn from watching video. *Asia-Pacific Science Education, 4*(6). https://doi.org/10.1186/s41029-018-0022-7

JCBN International School website. (2024). https://www.jbcnschool.edu.in/

KG Analytics. (2022). An overview: School education in Kyrgyzstan: What is to be done? Retrieved from https://kganalytics.fund/wp-content/uploads/2022/06/18-apr-2022_kg-analytics_overview-of-education-system.pdf

Khoiri, A., Evalina, Komariah, N., Utami, R. T., Paramarta, V., Siswandi, J., & Sunarsi, D. (2021). 4Cs analysis of 21st century skills-based school areas. Journal of Physics: Conference Series, 1764, Article 012142. https://doi.org/10.1088/ 1742-6596/1764/1/012142

Komba, A. & Shukia, R. (2023). An analysis of the basic education curriculum in Tanzania: the integration, scope and sequence of 21st century skills. *RISE Working Paper Series.* 23/129. https://doi.org/10.35489/BSG-RISE-WP_2023/129

Michael, T. D. (2022). *Pedagogical practices for nurturing the minds of the 21st century among non-formal secondary school learners in Tanzania* (Doctoral thesis). The University of Dodoma.

NAMA Foundation. (2020). *ROOTS Impact Report: October 2017-December 2019.* Retrieved from https://namafoundation.org/publications/#flipbook-df_21236/1/

Ratama, I. P., Padmadewi, N. N., & Artini, L. P. (2021). Teaching the 21st century skills (4Cs) in English literacy activities. *Journal of Educational Research and Evaluation, 5*(2), 223-233. https://doi.org/10.23887/jere.v5i2.30849

Rezandy, M. A. P., Artini, L. P. & Dewi, N. L. P. E. S. (2020). Teacher's strategies in promoting the 21st century learning skills on online class in tourism vocational high school. *Jurnal Ilmiah Pendidikan dan Pembelajaran, 4*(3), 603-608. https://ejournal.undiksha.ac.id/index.php/JIPP/article/view/28037

Rich, E. (Oct 11, 2010). How do you define 21st-century learning? *Education Week.* Retrieved from https://www.edweek.org/teaching-learning/how-do-you-define-21st-century-learning/2010/10.

Rolfes, T., Roth, J., & Schnotz., W. (2020). Learning the concept of function with dynamic visualizations. *Frontiers in Psychology, 11* (693), 1-16. doi: 10.3389/fpsyg.2020.00693

Roque Ferreira, B., Simões, J., & Ferreira, M. E. (2020). Effectiveness of educational practices in university students' knowledge about sun protection and its relation to sunlight exposure: An exploratory study in a Portuguese higher education institution. *European Journal of Investigative Health, Psychology and Education, 10*(3), 720-732. https://doi.org/10.3390/ejihpe10030053

Senjiro, U., & Lupeja, T. (2023). The development of 21st century skills to secondary school students in Tanzania: how competent are the teachers for the task? *International Journal of Education and Social Science Research, 6*(1), 107-126. https://specialreports.creativeassociatesinternational.com/whole-school -transformations-for-a-21st-century-tanzania/

Shabrina, A. & Astuti, U. P. (2022). The integration of 6Cs of the 21st century education into English skills: Teachers' challenges and

solutions. *Jurnal Pendidikan: Teori, Penelitian, dan Pengembangan, 7*(1), 28-37. https://doi.org/10.17977/jptpp.v7i1.15185

UNICEF Tanzania, (2024, May 31). *Government, Airtel, and UNICEF join hands to accelerate digital learning in Tanzania: The launch of the SmartWASOMI initiative.* Retrieved from https://www.unicef.org/tanzania/press-releases/government-airtel-and-unicef-join-hands-accelerate-digital-learning-tanzania#:~:text=This%20commitment%20is%20reflected%20in,dedication%20to%20advancing%20digital%20education.

Yulyani, Y., Miaz, Y., Fitria, Y., & Hidayati, A. (2023). Practicality of using interactive multimedia teaching materials with a STEM approach in elementary schools. *Jurnal Penelitian Pendidikan IPA, 9*(10), 8636–8640. https://doi.org/10.29303/jppipa.v9i10.5743