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LINKING HOME AND SCHOOL THROUGH MATHEMATICS HOMEWORK; INSIGHTS INTO EFFECTIVE INTERACTIVE MATHEMATICS HOMEWORK DESIGN FOR EARLY LEARNERS

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Abstract : *The phenomenon that many young learners continue to underperform due to limited home-based support and weak parental involvement. This study investigates the critical features of effective Interactive Mathematics Homework (IMH) as a strategy to enhance early-grade pupils' mathematics skills and foster meaningful parental engagement. Employing a qualitative case study design, data were collected through Focused Group Interviews (FGIs) with 63 parents and semi-structured interviews with 21 teachers and 10 head teachers across primary schools in Ukerewe District, Tanzania. Thematic analysis revealed four key characteristics of effective IMH, such ad a manageable number of questions, the inclusion of guided instructions, consistent feedback mechanisms, and alignment with the school curriculum. These elements were found to influence both the usability of the homework for families and its instructional value. The findings suggest that well-designed IMH can bridge the home–school gap in early mathematics education, encouraging collaborative efforts between teachers and parents. The study recommends integrating IMH into early-grade teaching practices to improve pupil outcomes and strengthen family-school partnerships in foundational mathematics learning.*

Keywords : *Home and School; Interactive Mathematics Homework; Early Learner.*

Abstrak : *Fenema bahwa banyak pelajar muda terus berprestasi buruk karena terbatasnya dukungan berbasis rumah dan lemahnya keterlibatan orang tua. Studi ini menyelidiki fitur-fitur penting dari Pekerjaan Rumah Matematika Interaktif (IMH) yang efektif sebagai strategi untuk meningkatkan keterampilan matematika siswa kelas awal dan menumbuhkan keterlibatan orang tua yang bermakna. Dengan menggunakan desain studi kasus kualitatif, data dikumpulkan melalui Wawancara Kelompok Terfokus (FGI) dengan 63 orang tua dan wawancara semi-terstruktur dengan 21 guru dan 10 kepala sekolah di seluruh sekolah dasar di Distrik Ukerewe, Tanzania. Analisis tematik mengungkapkan empat karakteristik utama IMH yang efektif, seperti jumlah pertanyaan yang dapat dikelola, penyertaan instruksi terbimbing, mekanisme umpan balik yang konsisten, dan keselarasan dengan kurikulum sekolah. Elemen-elemen ini ditemukan memengaruhi kegunaan pekerjaan rumah bagi keluarga dan nilai instruksionalnya. Temuan tersebut menunjukkan bahwa IMH yang dirancang dengan baik dapat menjembatani kesenjangan rumah-sekolah dalam pendidikan matematika awal, mendorong upaya kolaboratif antara guru dan orang tua. Studi ini merekomendasikan pengintegrasian IMH ke dalam praktik pengajaran kelas awal untuk meningkatkan hasil belajar siswa dan memperkuat kemitraan keluarga-sekolah dalam pembelajaran matematika dasar.*

Kata Kunci : *Rumah dan Sekolah; Pekerjaan Rumah Matematika Interaktif; Pembelajar Awal.*

INTRODUCTION

Mastery of mathematics is widely recognized as fundamental to students' future academic and professional success, particularly in fields like science, engineering, and technology (Yadav, 2019; Outhwaite et al., 2023). Foundational competence in mathematics not only enables cognitive development but also supports executive functioning and literacy skills (Kharis, Salsabila, & Haeruman, 2021). Numerous studies have shown that early mathematics proficiency is a strong predictor of long-term academic achievement (Clerkin & Gilligan, 2018; Harris & Petersen, 2022). Unfortunately, evidence from both developed and developing countries reveals that many students continue to struggle with mathematics from the early grades onward (Mullis et al., 2019; Mazana et al., 2020). In Tanzania, for example, several national assessments show persistently low mathematics performance among primary pupils, largely due to poor foundational skills (NECTA, 2019; RTI International, 2014).

Previous interventions have predominantly focused on improving instructional strategies and leveraging digital technologies (Lee & Choi, 2020; Kyaruzi et al., 2019), with limited attention to the critical role of parental involvement in supporting mathematics learning. Trako et al. (2019) suggest a disconnect between classroom instruction and home engagement, indicating a gap in parental participation despite its acknowledged significance in students' development. This gap highlights the need to examine models that actively engage parents in children's learning, especially through structured tools such as homework. Unlike prior studies that either explored the general benefits of parental involvement (Park & Holloway, 2017) or the impact of digital tools (Lee & Choi, 2020), this study uniquely focuses on the *qualities* of IMH as a dual-purpose intervention—strengthening foundational mathematics skills and empowering parental roles. The present research also contributes to a localized understanding within the Tanzanian education system, where empirical investigations on IMH are notably scarce.

Parental involvement has been shown to positively affect students' learning outcomes, particularly when it is part of a collaborative approach between schools and families (Asih, 2020; Hampden-Thompson & Galindo, 2016). International frameworks such as those from UNESCO (2013) and the UN Sustainable Development Goals (Goal 17) further emphasize the role of local communities and parents in enhancing educational success. In the Tanzanian context, legal and policy frameworks such as the Education Act No. 25 of 1978 and Curriculum Guidelines (URT, 2016, 2019) explicitly mandate parental participation in school governance and student learning, including mathematics.

Interactive Mathematics Homework (IMH) has emerged as a promising strategy to bridge the gap between schools and families. Literature shows that IMH fosters

communication between parents and teachers, strengthens student learning, and supports children's self-regulatory behaviours (Epstein et al., 2002; Van Voorhis, 2023; Moore & Ronau, 2024). While conventional homework strategies often neglect the diverse backgrounds and capacities of families, IMH is designed to be inclusive and supportive, offering guided, interactive tasks that involve parents meaningfully in the learning process (Berrezueta-Guzman & Pau, 2020).

Despite these benefits, several studies have also identified concerns regarding the implementation of homework programs. Parents frequently report a lack of preparedness and guidance, which limits their engagement (Hoover-Dempsey & Whitaker, 2013; Mwanamwambwa, 2021). Moreover, when poorly implemented, homework can interfere with family routines and contribute to student demotivation (Moroni et al., 2015; Williams & Williams, 2021). In the Tanzanian context, these challenges are compounded by a lack of empirical evidence on what constitutes effective IMH tailored to the needs of early-grade learners and their families. So, this study try to seeks to fill this gap by identifying the qualities of effective Interactive Mathematics Homework (IMH) that enhance both early-grade pupils' mathematics skills and parental engagement.

METHOD

This study used a qualitative approach with a phenomenological design to explore the direct experiences of teachers, principals, and parents in implementing effective Interactive Mathematics Homework (IMH) for the development of early grade students' mathematics skills and parental involvement. Operationally, data were collected through semi-structured interviews for teachers and principals, and Focus Group Discussions (FGD) for parents. Interviews were conducted directly in the school environment with interview guidelines that had been prepared based on the focus of the study. The researcher also recorded nonverbal expressions and social contexts during the interaction to strengthen the data. The phenomenological approach was chosen because it allows researchers to understand the subjective meaning of participants' experiences, especially related to the quality of IMH in improving children's mathematics learning at the elementary education level. The study was conducted in Ukerewe District, Tanzania, involving ten elementary schools as data collection locations. Participants consisted of 21 teachers, 10 principals, and 63 parents of early grade students. The selection of teachers and principals was carried out purposively because they have a direct role in learning and supervising the implementation of the 3R curriculum (reading, writing, arithmetic). The teachers included were pre-school to second grade teachers, who were the primary target for building the foundation of mathematics. The principals were selected because they had strategic insights into the

constraints and opportunities for collaboration between schools and parents. Parents were selected using convenient sampling, considering gender equality and the grade level of the children, with the assumption that they had direct experience in assisting children in completing homework and interacting with the school. Data were collected using semi-structured interviews (for teachers and principals) and FGDs (for parents). All conversations were recorded in Kiswahili, then transcribed and translated into English by a professional translator before being analyzed. The data analysis process used the thematic analysis method according to Braun and Clarke (2006), which began with the creation of a codebook based on an inductive approach from field data supported by relevant literature (Ryan & Bernard, 2003). Furthermore, the data were coded and extracted into Microsoft Excel using pivot tables to identify patterns and frequency of theme occurrence. The results of the analysis are presented in narrative form supported by percentages and direct quotes from participants. This procedure was carried out by the research team with consensus discussions to ensure the validity of the data interpretation.

RESULT AND DISCUSSION

The results showed that there were both diverse and similar views among participants regarding the qualities of effective homework. As shown in Table 1, several qualities were generally considered important, such as a manageable number of questions, clear instructions, and curriculum-alignment. In addition, there were also different views among the respondent groups. Teachers and principals tended to emphasize the importance of feedback as an important component of IMH, while parents did not explicitly mention this aspect. In contrast, parents and principals emphasized the importance of flexibility in implementing instructions, which was not specifically a concern for teachers.

Table 1: Qualities of an effective IMH

Qualities	Teachers	Parents	HTs
Manageable number of questions	13 (41.93)	18 (23.68)	6 (28.57)
Guided instructions	6 (19.35)	38 (50)	4 (19.04)
Feedback	11 (35.48)		9 (42.85)
Curriculum focused	5 (16.12)	16 (21.05)	1 (4.76)
Allowing flexibility		4 (5.26)	1 (4.76)
	31 (100)	**76 (100)**	**21 (100)**

These findings suggest that designing effective IMH needs to consider the perspectives of various education stakeholders, especially in bridging expectations between school and home. Elements such as a reasonable number of questions, clear instructions, integration with the curriculum, consistent feedback, and flexibility of methods are

important foundations in designing interactive mathematics homework that can be optimally used by teachers, students, and parents.

1. Manageable Number of Questions

The analysis of the participants' responses (teachers -41.93%, parents -23.68%, and HTs -28.57%) indicated that for an IMH to be effective, the number of questions assigned must be manageable. It was reported that the number of questions must not be too many instead should be sufficient and doable. Specifically, parents said that a large number of questions consume more of their time and affect their engagement in other activities. Additionally, parents argued that when the number becomes too much, the exercise becomes boring not only to them but also to children. In this view, the parents argued for teachers to prepare an IMH that can be enjoyable to them. Thus have a reasonable number of questions. In this regard, one parent said;

> A good homework does not make the parent feel tired to support the child's learning. Becoming tired is a result of the teacher's provision of many questions that may hinder the parents' engagement in other activities. Therefore, the teacher must provide a few questions that shall allow parents to support the child's learning and proceed with his/her schedule (FGI-parent at school F, November, 2023).

Another parent added;

> When the questions are too many, even the children themselves do not like it, they get bored. They prefer to do it quickly and then go to play. Once they realize they have spent too much time, they get tired and bored (FGI-parent at school A, November, 2023).

The expressions by the parents depict that a large number of questions not only affect parents' schedules but also cause pupils to become bored and tired. This entails that for the IMH to be effective, teachers should design some questions that will not affect parents' daily timetables. Similar to parents, teachers argued that when the number of questions is reasonable, children get ample time to discuss with their parents. Different from that, children and parents become bored. Additionally, teachers said that a large number of questions consume more teachers' time thereby resulting in the ineffectiveness of other school work, while a reasonable number allows the accommodation of all school activities. In this regard the teacher substantiated;

> There are many students in the class. Therefore, to be effective you must provide a few questions to mark them timely. But also when you give parents a lot of work for supervising their children, they do not feel comfortable, they lament that the questions are too many (FGI-parent at school I, November, 2023).

From this view, it can be learnt that the pupil-teacher ratio in class can influence the number of questions to be provided. However, whether there are many or few pupils

in class, a reasonable number of questions is recommended. This is because it allows all involved parties (teachers, parents and pupils) to engage in IMH without affecting their other core businesses.

2. Guided instructions

The analysis of the findings depicted that for IMH to be effective, they must have guided instructions. Guided instructions as suggested by respondents involve methodological instructions that can be used to solve a particular mathematics task. It was stated that, in most cases, parents are unaware of the instructions that are required for solving a specific task. Therefore, teachers should provide suggestive instructions that can guide parents to perform a specific task. Of particular concern, the parents argued that guided instructions help them to know the methods used by the teacher at school so that they may not confuse the children. In a similar view, teachers presented that providing an IMH with guided instructions helps parents know the easiest ways to support their children's mathematics abilities. The said instruction involves the step-by-step procedures for doing the tasks given. Regarding guided instructions, parents and teachers had the following to say;

> You know we have completed school a long time ago. Therefore, we have already forgotten some of the issues. For the homework to be effective, teachers should provide us the strategies to use in supporting our children's learning. Without given instructional strategies we find ourselves spending much time and energy to be understood by children (FGI-parent at school F, November, 2023).

Similarly, one teacher added;

> It is better to guide parents on the procedures to use to help their children learn mathematics skills because others do not know and sometimes they use different methods used at school. This sometimes makes children fail to understand which method to observe (Interview-teacher at school D, November, 2023).

The teacher's and parents' expressions indicate that because parents may have forgotten some procedures to observe when helping children with mathematics skills, it is better to be guided. This helps them to stay focused on the right procedures to help their children accordingly and use little effort. Short of that parents may see the exercise as difficult, demanding and unfriendly.

3. Curriculum focused

The findings also depicted that the IMH should focus on the curriculum. Several reasons for focusing on the curriculum were eared out. First, parents are always not aware of the ongoing curriculum. Therefore, providing homework that focuses on the curriculum helps them to know the right content to help their children. Second, the focus on curriculum helps teachers to simplify pupils' learning. Pupils' learning is simplified since parents at home provide a supportive role at home which focuses on the ongoing

curriculum. Therefore, when pupils come to school the next day it becomes easy for them since they have done the exercises at home. Regarding curriculum focus, one parent said;

> We do not have the books that are used by teachers at school, therefore, teachers are supposed to give the pupils the activities they are teaching in class so that we may also help them with the content that is according to their level rather than guessing what is above their level (FGI-parent at school J, November, 2023)

Similarly, one head teacher said;

> In most cases, when the teacher concentrates on what he/she is teaching in class, it helps because children are doing some practice at home. Therefore, even when they come to school, it becomes easy for them to understand what is being taught (Interview-HT at school H, November, 2023).

The expressions from the parents and the teacher reveal that providing IMH that focuses on curriculum helps parents to know and assist their children while focusing on the curriculum and age-appropriate. Additionally, it can help parents to provide additional mathematics exercises by reflecting on the provided homework. Ultimately, children do more mathematics exercises at home which simplifies their mathematics learning at school.

4. Feedback

While teachers and head teachers suggested that the IMH should be able to facilitate feedback to the participating parties, parents did not mention it. Teachers (35.48% of responses) and HTs (42.85% of responses) argued that for the IMH to be effective, it should be able to provide feedback between teachers and parents. Thus, the IMH should have a section that allows a teacher and parent to share ideas regarding the homework provided. This enables the parent to provide their positive and negative views regarding the work given. They can request more instructions from the teacher or ask for any information from the teacher. Likewise, the teacher can respond to the views given by the parent and work collaboratively to help children's learning. Additionally, teachers can send the information to the parents to receive feedback. Therefore, the communication section helps to keep constant communication between teachers and parents. For instance, one parent argued;

> Homework should help to create a communication space between the teacher and parents. Sometimes you find as a parent you don't have an airtime bundle for communication. Therefore, in the case when there is a space for communication with the teacher it helps to reduce the communication costs, thereby providing us with the opportunity to share our ideas regarding our children's learning (FGI-parent at school C, November, 2023).

In other views, the teacher noted;

> The feedback section helps us to know whether the parent has participated in the work given at school or not. But also we learn from parents the challenges facing them and design how to help them more (Interview-teacher at school F, November, 2023).

The extracts from the parents and the teachers are an indication that the feedback in the IMH facilitates easy communication between the teacher and parents. Furthermore, it is the cheapest method of communicating with parents. Of specific interest is that teachers get an opportunity to share the information with the parents timely regarding children's learning progress and holistic development at school.

The results of the study indicate that the effectiveness of Interactive Mathematics Homework (IMH) is greatly influenced by a number of basic qualities, one of which is the number of questions managed. This finding strengthens Bluestein's opinion (2006) who emphasized that too many questions in homework actually reduce parental participation because it takes up time and disrupts their daily schedule. In this context, the function of homework shifts from a collaborative learning medium to an additional burden for families. Songsirisak (2019) also stated that the many activities actually make students feel bored and burdened, thus damaging their motivation to learn. Therefore, an overly dense task structure can create dysfunction in home-school interactions. Based on this, it can be interpreted that an effective IMH structure is one that considers the active involvement of all parties through a friendly and proportional approach to the time and capacity of parents and students. This emphasizes that in the design of IMH, teachers need to understand the social structure of students' households so that homework is not exclusive and adds to the burden. The existence of guided instructions has proven to be crucial in supporting parental involvement in guiding their children at home. Rahmani and Rexhepi (2024) stated that clear instructions can avoid confusion between teacher and parent guidance, so that children get consistent direction at home and school. Research by Moore & Ronau (2024) and Yavich and Davidovitch (2020) supports this by emphasizing the importance of uniformity in learning approaches between home and school environments. The theoretical implication is that guided instruction is not only a technical aid, but also acts as a structural link between two different learning environments. In this context, this study adds a new dimension, namely the role of guided instruction as a bridge for parents who have pedagogical limitations. Thus, the IMH instructional structure must take into account the background knowledge of parents, making them active and effective partners in assisting their children's learning process.

The research findings also emphasize the importance of focusing homework on the curriculum as a strategic element in maintaining the continuity of student learning. In line with the findings of Durisic and Bunijevac (2017), curriculum-oriented homework helps

parents understand and follow the level of their children's learning development, and prevents learning gaps. However, this study goes further by suggesting that this alignment not only supports consistency, but also allows parents to create additional, contextually relevant activities. This suggests a dual function of the curriculum in IMH: as a formal learning reference and as a trigger for creative interventions from families. This structure strengthens the position of parents as pedagogical agents, and not just recipients of school instruction. Thus, the integration of curriculum content and homework design has theoretical implications for the need to develop a curriculum-participatory collaboration model that connects school and home more systematically.

Another important component of IMH identified in this study is the feedback mechanism between teachers and parents. Yavich and Davidovitch (2020) stated that through feedback, teachers can understand the challenges faced by parents, while at the same time adjusting a more targeted teaching approach. Meanwhile, Negru and Sava (2023) highlighted the role of feedback as a tool to evaluate the effectiveness of homework and determine the direction of further learning. However, this study shows a broader dimension, that parents also rely heavily on feedback from teachers to improve their supervision of their children's learning process. This means that the feedback function is not only evaluative, but also instructional and motivational. Williams and Williams (2021) and Songsirisak (2019) added that students who know that there is active communication between teachers and parents will appreciate the learning process more because they feel supported as a whole. Therefore, the communication structure in IMH must be two-way, synergizing between the school and home in building a mutually reinforcing learning ecosystem.

CONCLUSION

The results of this study provide an important lesson that the effectiveness of Interactive Mathematics Homework (IMH) does not only depend on the existence of assignments as a learning tool, but also on how the assignments are strategically designed to bridge the relationship between home and school. The main lesson from this study is that good IMH must meet four key characteristics, namely: a manageable number of problems, guided instruction, consistent feedback, and alignment with the curriculum. These four elements enable more meaningful parental involvement and increase the effectiveness of the mathematics learning process at the early grade level. Therefore, IMH plays a role not only as a cognitive tool, but also as a bridge of communication and collaboration between educators and families.

The scientific contribution of this study lies in strengthening the theory of parental involvement and interactive task design in the context of elementary education in

developing countries, especially in Tanzania. Different from previous studies that emphasize more on educational technology or formal pedagogical approaches in schools, this study broadens the scope by highlighting the structure of homework as an inclusive social and pedagogical intervention space. In addition, the results of this study also enrich the literature on elementary mathematics education by adding a local perspective based on the direct experiences of teachers, principals, and parents to the practice of IMH. This study suggests that early grade teaching practices systematically integrate IMH as a strategy to strengthen home-school synergy.

However, this study also has several limitations. First, spatially, this study was only conducted in Ukerewe District, Tanzania, so generalization of the results to other geographic or social contexts needs to be done with caution. Second, the study participants were predominantly teachers and parents from early grade levels, so the involvement of the students themselves as direct users was not explicitly expressed. Third, although the phenomenological approach enriches contextual understanding, the qualitative method used limits the possibility of quantitative measurement of the effectiveness of IMH longitudinally. Therefore, further research using quantitative or mixed-methods approaches, with wider geographical coverage and demographic variation, is highly recommended to strengthen the generalizability of the findings and explore more deeply the long-term impact of IMH implementation on student learning outcomes.

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