

Development of Magic Disk Learning Media for Indonesian Ethnic and Cultural Diversity Among Fifth-Grade Students

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Abstract

Purpose: This study aimed to develop the Magic Disk learning medium for the topic of Indonesian ethnic and cultural diversity, evaluate its feasibility through expert validation, and examine its effectiveness in improving fifth-grade social studies learning outcomes.

Methodology: The study employed a Research and Development approach using the 4D model (Define, Design, Develop, Disseminate). The product consisted of a laminated double-spinner disk. Effectiveness was evaluated using a one group pretest–posttest design involving 30 fifth-grade students at MI Persis 72 Gunung Buntung, Serang Regency, Indonesia. Data were collected through observation, interviews, questionnaires, documentation, and achievement tests, and analyzed using descriptive statistics, a paired-sample t-test, and normalized gain.

Results: Expert validation reached 83.90% (very feasible), while teacher and student responses were 91.07% and 93.83%, respectively (very good). The mean score increased from 61.64 to 84.70, with a significant improvement ($t = 6.359$, $p < .001$, $d = 1.16$). The normalized gain was 0.60 (moderate), and the standard deviation decreased from 19.11 to 6.59.

Conclusions: The Magic Disk proved feasible, practical, and associated with significant improvements in students' social studies achievement while reducing score variability. Owing to the absence of a control group, these improvements should be interpreted as associated with, rather than caused by, the intervention.

Limitations: The study involved a single school, one group pretest–posttest design, a short implementation period, and one instructional topic.

Contributions: The study provides an inexpensive, non-digital gamified learning medium for elementary social studies and contributes evidence supporting manipulative media to enhance classroom engagement and learning outcomes.

Keywords: *Cultural Diversity, Learning Media, Learning Outcomes, Magic Disk, Social Studies*

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1. Introduction

Basic education carries the responsibility of laying the cognitive, affective, and social foundations on which later schooling is built. Within the elementary curriculum, social studies occupies a distinctive position because it addresses not only academic concepts but also the way learners locate themselves within a wider society. Social studies instruction is designed to help learners understand social dynamics, strengthen a sense of national identity, and internalise the cultural and social values of the nation, which makes it a central vehicle for cultivating civic awareness and tolerance from an early age. The subject integrates sociology, history, geography, and economics so that learners acquire the capacity to interpret real social conditions rather than memorise isolated definitions ([Kanji, & Nawir, 2019](#); [Hermanto, Japar, & Utomo, 2019](#)).

In the Indonesian context, this civic function is inseparable from the plurality of the nation itself. Indonesia is home to thousands of ethnic communities, each with distinctive languages, customary dwellings, garments, culinary traditions, and performing arts. Such richness constitutes a national asset, yet it also demands a deliberate educational effort to sustain social harmony ([Musyarofah, Halimah, Fashihullisan, & Ismaya, 2025](#)). Social studies education that embraces multiculturalism therefore functions as an instrument for building mutual respect, tolerance, and appreciation of difference within a heterogeneous social environment ([Saputra, 2024](#); [Gay, 2013](#)). Early exposure to diversity matters because the elementary years are precisely when children consolidate their dispositions towards peers from different backgrounds ([Saqjuddin, Parisu, & Saputra, 2025](#); [Saqjuddin, Usman, Puteri, & Sisi, 2026](#)).

The topic of ethnic and cultural diversity is nevertheless one of the most demanding units in the elementary social studies curriculum. It requires learners to associate dozens of provinces with their respective ethnic groups, traditional houses, garments, dances, and musical instruments. When such content is delivered only through lecture and printed textbooks, learners struggle to construct the mental imagery needed to retain it, and the material quickly degenerates into rote memorisation ([Safitri & Jupriyanto, 2025](#)). Studies of elementary classrooms report that instruction remains predominantly teacher-centred, with the lecture method still dominant and learners positioned as listeners and note-takers rather than active participants ([Erdilanita, Carsiwan, & Taufiq, 2025](#)). The integration of instructional media in these classrooms is minimal; teachers rely on textbooks and whiteboards without visual or interactive resources capable of strengthening comprehension, which renders the learning experience monotonous and depresses attention ([Puspitasari, Sari, Putri, & Wuryani, 2018](#)).

The consequences of this pattern are visible in classroom behaviour and in achievement data. Learners appear passive and disengaged during social studies lessons, are reluctant to ask questions or join discussions, and display limited retention of conceptual content presented in textual form without adequate visual support ([Arifin, & Rizqiyani, 2025](#); [Safitri, Noviyanti, Chan, Nurluthvia, & Simatupang, 2024](#)). Achievement on the diversity unit consequently falls below expectations, signalling a need for more innovative and interactive instructional resources aligned with the characteristics of elementary learners ([Ningrum & Nugraheni, 2025](#)). The scarcity of engaging learning resources is itself an obstacle to raising the quality of social studies instruction, because interactive resources are what draw learners into exploration, educational play, and media-based discussion ([Hasibuan, Sari, Amelia, Musa, & Gusmana, 2025](#)).

Instructional media are therefore not decorative additions but pedagogical necessities. They render abstract ideas concrete and accessible, which matters especially for elementary learners who operate within the concrete operational stage and benefit from visual scaffolds and direct experience. Carefully designed and interactive material raises concentration, involvement, and enthusiasm, and learners recall information more readily when it is presented through enjoyable and relevant experiences. Innovation in media need not be digital; simple, creative, and manipulative resources that involve learners directly in the learning process are equally capable of producing these effects ([Ambarwati, Wibowo, Arsyiadanti, & Susanti, 2022](#); [Mahardika, Syaodih, & Djoehaeni, 2025](#)). What

matters is the fit between the resource and the learning preferences of the target group, since madrasah learners typically favour hands-on, visual, and activity-oriented instruction ([Komara, Pamungkas, & Dewi, 2022](#)).

The Magic Disk is proposed here as one such resource. It is a rotary disk medium that combines images, colour, text, and a spinning mechanism so that learners not only observe the content but physically manipulate it in order to reveal information. Its construction is deliberately simple: one or more circular layers rotate around a central axis, a window or pointer reveals one sector at a time, and each sector carries a compact combination of image and text about a particular region of Indonesia. Because the medium is light, reusable, and independent of electricity or connectivity, it can be used in individual, small-group, or whole-class configurations without technical support ([Fitrihandayani, Darsono, & Sudirman, 2023](#)). Visual cues such as traditional houses and garments help learners visualise and retain otherwise abstract cultural content by [Raudah, Suriansyah, and Cinantya \(2024\)](#), while the act of spinning, answering, discussing, and completing quizzes shifts the locus of activity from the teacher to the learner.

A spring mechanism installed at the central axis distinguishes the Magic Disk from an ordinary rotating chart. Working on the principle of elastic force, the spring stores the energy imparted by the learner and releases it gradually, producing a rotation that is neither too fast nor too slow and that decelerates smoothly ([Karimah, Antika, & Nur, 2025](#)). As the disk slows, contact between the spring and the sector dividers generates a small clicking effect, so that the disk halts at an unpredictable sector in the manner of a prize wheel ([Mariati & Mustaji, 2025](#)). This element of surprise is pedagogically consequential: it generates curiosity, anticipation, and emotional involvement, and it embeds a gamified structure within an otherwise conventional lesson ([Purwanti & Fanani, 2024](#)). Learner participation then engages psychomotor, cognitive, and affective dimensions simultaneously, which is precisely the condition under which learning becomes meaningful ([Maghfiroh, Daksana, & Salma, 2024](#)). A quick response code affixed to the reverse of the disk, to the worksheet, or to the teacher guide extends the physical medium towards supplementary videos, additional material, and interactive quizzes, giving the resource a blended character.

The gap addressed by this study lies between curricular expectation and classroom reality. The curriculum calls for active, engaging, learner-centred instruction, whereas observed practice in fifth-grade madrasah classrooms remains lecture-dependent with limited learner participation, and innovative media capable of attracting interest and sustaining motivation are largely absent. No manipulative rotary medium addressing Indonesian ethnic and cultural diversity had yet been developed or implemented at the research site. The rotary disk format is not itself new for this topic: [Galuh \(2016\)](#) have already developed comparable disk media for the same content domain at the elementary level. The contribution claimed here is therefore procedural and contextual rather than conceptual, and consists of documenting a complete 4D cycle, validation across four domains of expertise, staged trials running from one-to-one evaluation through small-group and field testing to full implementation, and inferential testing of the outcome within a Islamic elementary school (*Madrasah Ibtidaiyah* or MI), a combination not reported in the earlier work. Accordingly, this study asks two questions: first, what are the present conditions of social studies instruction on Indonesian ethnic and cultural diversity in the fifth grade of MI Persis 72 Gunung Buntung; and second, how feasible is the developed Magic Disk medium and how far is its use associated with improved learning outcomes on that topic.

2. Literature Review and Hypotheses Development

2.1 Learning Media in Elementary Social Studies Education

Learning media are the channels through which instructional messages are transmitted from teacher to learner, and their function extends beyond illustration to the regulation of attention, motivation, and comprehension ([Rahayuningsih, Hidayah, & Primar, 2022](#); [Haptanti, Hikmah, & Basuki, 2024](#)). In elementary settings their contribution is particularly pronounced because learners at this stage think concretely and depend on perceptible referents to construct meaning from abstract propositions.

Evidence from elementary classrooms shows that media use raises attainment across subjects: interactive media improved achievement in civics through locally grounded content by [Adelia and Wandini \(2023\)](#), audio-visual media raised social studies achievement in the fourth grade by [Fitrihandayani, Darsono, and Sudirman \(2023\)](#), and concrete manipulatives improved achievement in natural and social sciences ([Mustaqimah & Astuti, 2024](#)). The same pattern is reported internationally: multimedia arrangements that pair pictorial and verbal representations outperform verbal presentation alone, because the two codes are processed in partly separate channels and support one another at retrieval ([Clark, & Paivio, 1991](#); [Mayer, 2017](#)).

The absence of media produces the inverse effect. Instruction anchored exclusively in textbooks weakens learners' conceptual understanding in social studies because the printed page cannot supply the spatial and cultural imagery the subject demands ([Karima, Erni, Febriani, Handini, Palupi, Lestari, Cantika, Ramadhan, & Alitasari, 2025](#)). Teacher competence in exploiting even simple media is therefore an important determinant of learning quality ([Azima, Dewi, Amalia, Cornellya, & Wismanto, 2024](#)). Colour, layout, and illustration are not cosmetic choices either; visual stimulation influences how effectively primary-grade learners attend to and process classroom material ([Julianto, & Cahyadi, 2020](#); [Fajrie, & Kurniati, 2023](#)). These findings converge on a single implication for the present study: a medium that presents cultural content visually, invites physical manipulation, and organises information into discrete, digestible sectors should support comprehension more effectively than textbook exposition alone.

2.2 The Magic Disk as a Manipulative and Gamified Medium

The Magic Disk belongs to the family of manipulative visual media, in which learning is mediated by an object the learner physically operates. Its rotary structure allows a large body of information to be stored in a single compact artefact and released one sector at a time, which limits the cognitive load imposed at any given moment while preserving the breadth of the topic. Segmenting material in this way is one of the established means of keeping intrinsic and extraneous load within the limits of working memory, and meta-analytic evidence indicates that concrete manipulatives raise attainment relative to abstract symbolic instruction, particularly for younger learners working with unfamiliar content ([Mayer, & Moreno, 2003](#); [Sweller, van Merriënboer, & Paas, 2019](#); [Carbonneau, Marley, & Selig, 2013](#)). Rotary media of this type have been shown to raise interest and achievement in elementary mathematics by [Faradila and Pratiwi \(2024\)](#), and game-based learning more generally has a positive influence on elementary learners' motivation ([Putra, Cumalasari, Fusanita, & Hidayati, 2024](#)).

The gamified dimension of the medium rests on the unpredictability introduced by the spring mechanism. Gamification imports game elements into instruction in order to raise motivation and engagement, and the randomness of the stopping position supplies exactly the anticipation and curiosity on which that effect depends ([Purwanti, & Fanani, 2024](#); [Mariati, & Mustaji, 2025](#)). Meta-analyses report small to moderate positive effects of gamified and game-based arrangements on both cognitive and motivational outcomes, with the strongest effects where the game elements are tied to the learning content rather than to reward alone by [Sailer and Homner \(2020\)](#) and [Wouters, van Nimwegen, van Oostendorp, and van der Spek \(2013\)](#), a pattern consistent with accounts of intrinsic motivation in which curiosity and perceived autonomy sustain engagement ([Ryan & Deci, 2000](#)). Because the learner must spin, wait, read, and respond, the activity recruits psychomotor, cognitive, and affective processes at once, a combination associated with stronger retention than passive reception. Active learning arrangements of this kind have been reported to raise participation among madrasah learners specifically, and student-centred approaches consistently outperform teacher-centred delivery in terms of engagement ([Erdilanita, Carsiwan, & Taufiq, 2025](#); [Maghfiroh, Daksana, & Salma, 2024](#); [Arifin, & Rizqiyani, 2025](#)).

2.3 Learning Outcomes

Learning outcomes denote the changes in behaviour and capability a learner exhibits after instruction, encompassing cognitive, affective, and psychomotor domains in the revised Bloom taxonomy ([Nafiati, 2021](#)). This study concentrates on the cognitive domain, operationalised through an

achievement test covering recall, comprehension, and application of the diversity material. Achievement is jointly determined by internal factors such as motivation, interest, and prior knowledge and by external factors such as teaching method, teacher competence, learning environment, and the availability of media ([Gunawan, Kustiani, & Hariani, 2018](#); [Restu, & Santosa, 2021](#)). Low achievement in elementary classrooms is frequently traced to weak conceptual understanding produced by instruction that fails to make concepts perceptible ([Putra, Hefni, & Erningsih, 2022](#); [Ihza, Hidayat, & Setiyawati, 2025](#)). Media that concretise abstract content therefore act directly on one of the modifiable determinants of achievement, which is the theoretical warrant for expecting the Magic Disk to raise test performance.

2.4 Previous Relevant Studies and Research Gap

Three prior studies bear directly on the present work. [Galuh \(2016\)](#) developed a Magic Disk for the same social studies topic at an elementary school in Bangil and reported a t-test result in which the calculated value of 4.777 exceeded the critical value of 2.052, indicating a significant difference in achievement before and after use of the medium. ([Galuh, 2016](#)) developed a Smart Disk for the same content domain in the fifth grade and documented progressive gains across instructional cycles, with the class mean rising from 57.11 with 16% mastery to 68.84 with 46% mastery, and subsequently to 82.57 with 84% mastery. A further study applying a Science Magic Disk within a creative problem-solving design reported the same pattern of staged improvement in achievement and mastery.

These studies establish that disk-based media can raise achievement, yet three limitations remain. First, none reports a full 4D development cycle validated by material, media, language, and instrument experts. Second, none documents staged user trials progressing from one-to-one evaluation through small-group trial to field implementation. Third, none is situated in a madrasah ibtidaiyah, where the curricular emphasis on tolerance and national unity gives the diversity topic additional weight. The present study addresses these gaps by combining systematic development, multi-expert validation, staged trials, and inferential testing within a single madrasah setting.

2.5 Hypothesis Development

Because instructional media that concretise abstract content are theoretically expected to raise cognitive achievement, and because prior disk-based studies have consistently reported such gains, the following hypotheses were formulated:

H₀: There is no significant difference in the learning outcomes of fifth-grade students before and after the use of the Magic Disk learning medium on the topic of Indonesian ethnic and cultural diversity

H₁: There is a significant difference in the learning outcomes of fifth-grade students before and after the use of the Magic Disk learning medium on the topic of Indonesian ethnic and cultural diversity

3. Research Methodology

3.1 Research Design

This study employed a Research and Development design, which is intended to produce a specific product and to assess its feasibility, practicality, and effectiveness in addressing an identified instructional problem ([Afifah, Kurniaman, & Noviana, 2022](#)). The approach was selected because it does not stop at describing a phenomenon but delivers a usable artefact together with empirical evidence of its performance, thereby joining theoretical inquiry to practical application in the field ([Indaryanti, Murtiyasa, & Soemardjoko, 2025](#)). Continuous evaluation through expert validation and field trials is intrinsic to the method, allowing successive refinement of the product until an acceptable standard is reached ([Pramesti & Mashabi, 2023](#)).

The development framework adopted was the 4D model of [Thiagarajan, Semmel, and Semmel \(1974\)](#), comprising the Define, Design, Develop, and Disseminate stages. The 4D model was chosen for its structured, straightforward character and its established applicability to the creation of instructional media for elementary and Islamic elementary schools ([Indaryanti et al., 2025](#)). Effectiveness testing

within the Develop and Disseminate stages used a one-group pretest-posttest arrangement ($O_1 X O_2$), in which a pretest establishes prior knowledge, the treatment consists of instruction mediated by the Magic Disk, and a posttest measures the resulting change. This arrangement is appropriate for measuring change in achievement and for validating interactive instructional products in Indonesian basic education settings, since it registers the difference between initial and final conditions following treatment ([Khoirunnabila, Oksanda, & Indayati, 2024](#)). The arrangement is nevertheless pre-experimental. Without a parallel control class it cannot separate the contribution of the medium from maturation, the testing effect, history, or regression towards the mean, and its results are accordingly reported throughout this article in associative rather than causal terms ([Marsden & Torgerson, 2012](#)).

3.2 Research Setting and Participants

The study was conducted at MI Persis 72 Gunung Buntung, a private Islamic elementary school under the Ministry of Religious Affairs located in Kramatlaban Village, Padarincang District, Serang Regency, Banten Province. The *madrasah* has operated since 2002, holds a B accreditation, and serves 367 learners across twelve classrooms with a teaching staff of twenty-one. Facilities include a laboratory, an LCD projector, whiteboards, and visual aids, but no library, so classroom media carry a proportionally greater share of the instructional load.

Participants were fifth-grade learners aged ten to eleven years, drawn from the fifth-grade cohort of thirty learners enrolled at the madrasah. The staged trials involved three learners of heterogeneous ability in the one-to-one evaluation, ten randomly selected learners in the small-group trial, and twenty-four learners in the field trial. The full implementation at the Disseminate stage involved all thirty learners, who constituted the sample for the pretest, posttest, and response questionnaire. Because the madrasah operates a single class at this grade level, these four groups were not independent samples: every learner who took part in a formative trial was also part of the implementation cohort. Prior contact with the medium during the one-to-one, small-group, and field stages may therefore have contributed to posttest performance at implementation through practice and repeated-testing effects. This dependence between stages is treated as a limitation of the design in Section 5.2 rather than as a controlled feature of it. The fifth-grade classroom teacher acted as observer and practitioner validator.

3.3 Development Procedure

3.3.1 Define

The Define stage established the instructional requirements through front-end analysis, curriculum and material analysis, learner analysis, and task and concept analysis. Classroom observation, interviews with the fifth-grade teacher, document analysis, and identification of learner characteristics were used to surface the problems constraining social studies instruction, in particular the dominance of lecture delivery, weak motivation, and difficulty in grasping abstract sociocultural concepts ([Permadi & Zannah, 2023](#); [Lestari & Setiawan, 2024](#)). The broad diversity content was then deconstructed into compact essential subtopics suited to the capacity of the medium.

3.3.2 Design

The Design stage produced the initial prototype together with the storyboard, usage instructions, question cards, and evaluation instruments. Content selection was aligned with the learning outcomes prescribed for the fifth grade; visual layout combined colour, illustration, and text; and interactivity decisions determined how learners would spin the disk, match images to written content, and take part in educational games. Design choices were governed by ease of use for both teacher and learner, aesthetic appeal, and consistency with the concrete operational stage of cognitive development ([Ayu, Fransiska, Suarni, & Margunayasa, 2024](#)). Supporting instruments developed at this stage, following the sequence used in comparable design work by [Ismail, Eraku, and Lahay \(2025\)](#), included the teaching module, the learner worksheet, validation sheets, response questionnaires, and the pretest and posttest items.

3.3.3 Develop

The Develop stage realised the physical prototype and subjected it to evaluation. The disk was produced from thick adhesive-backed cardboard finished with glossy lamination so that the product would resist tearing, remain safe, and stay ergonomic when rotated by learners. The medium and all instruments were then validated by material, media, language, and instrument experts, after which the product underwent one-to-one evaluation, a small-group trial, and a field trial. Feedback from each round informed successive revisions ([Pramesti & Mashabi, 2023](#); [Utari & Ramadan, 2023](#)).

3.3.4 Disseminate

The Disseminate stage delivered the finished product to its intended users. Dissemination took the form of peer socialisation and live demonstration of the medium before the fifth-grade teacher and the social studies teaching group, followed by formal handover of a ready-to-use Magic Disk unit and its operational guide to the madrasah authorities, so that the resource would remain available in subsequent academic years ([Afifah et al., 2022](#); [Indaryanti et al., 2025](#)).

3.4 Instruments

Data were collected through observation, interviews, questionnaires, documentation, and achievement testing ([Ardiansyah, Risnita, and Jailani \(2023\)](#)). Direct observation recorded the conduct of instruction and learner engagement; interviews with the classroom teacher and selected learners captured needs and perceptions; questionnaires measured expert judgement and user response; documentation covered school profile data and instructional records; and the pretest and posttest measured cognitive attainment on the diversity topic. The validation instruments comprised separate sheets for material, media, language, test, and non-test experts, each addressing the dimensions specific to that domain of expertise. Expert judgement and response questionnaires used a four-point Likert scale, with the exception of the material validation sheet, which used a five-point scale; the percentages reported in Section 4.3 are computed against the maximum of the scale actually applied in each sheet.

3.5 Validity and Reliability

Content validity of the medium and instruments was established through expert judgement, which reduces rating bias and secures the dependability of both the content and the physical product before wider implementation ([Banu & Rahman, 2025](#)). Five validation panels were constituted, covering material, media, language, test instruments, and non-test instruments. Each panel comprised one or more experts qualified in the relevant field, with the number of raters varying by domain. Where a domain was rated by a single expert, the resulting percentage expresses that expert's judgement alone and no inter-rater agreement index could be computed; agreement coefficients such as [Aiken \(1985\)](#) require at least two independent raters per item, and their use with a larger panel is recommended for any subsequent development of the medium. Item validity of the achievement test was examined through item analysis, and reliability was estimated using internal consistency procedures appropriate to dichotomous achievement data ([Diniarti & Sulianto, 2023](#)). Only items meeting the validity and reliability criteria were retained in the final pretest and posttest.

3.6 Data Analysis Techniques

Quantitative validation and response data were converted into percentages using Formula 1, in which the empirical score obtained from the rater is divided by the maximum attainable score:

$$P = \left(\frac{\sum x}{\sum x_i} \right) \times 100\% \quad (1)$$

Formula 1 shows the conversion of raw Likert scores into a feasibility percentage, where $\sum x$ is the total score awarded by the validator and $\sum x_i$ is the maximum possible total. The resulting percentages were interpreted against the feasibility criteria adopted from [Afifah et al. \(2022\)](#), in which values above 80% up to 100% are classified as very feasible, values above 60% up to 80% as feasible, values above 40% up to 60% as adequate, and values up to 40% as not feasible.

$$g = \frac{S_e - S_i}{S_m - S_i} \quad (2)$$

Formula 2 shows the normalised gain, where S_e is the posttest mean, S_i is the pretest mean, and S_m is the maximum attainable score. Index values of 0.70 and above indicate a high category, values from 0.30 up to 0.70 a moderate category, and values below 0.30 a low category (Hake, 1998). Inferential testing of the hypothesis used a paired-sample t-test at the 0.05 significance level. Because the design compares two measurements taken on the same learners, the assumption to be examined is the normality of the pretest–posttest difference scores; homogeneity of variance is a requirement of tests comparing two independent groups and is not applicable to a paired design, so it was not tested. Normality of the difference scores was examined with the Shapiro–Wilk test, and a Wilcoxon signed-rank test was prepared as the non-parametric alternative in the event that the assumption was not met (Ghasemi & Zahediasl, 2012). The practical magnitude of the difference was expressed as Cohen d for paired samples, computed as the t-value divided by the square root of the sample size, together with the 95% confidence interval of the mean difference (Lakens, 2013). Qualitative data from observation and interviews were analysed descriptively through data reduction, display, and conclusion drawing, and were used to corroborate the interpretation of the quantitative findings (Qomaruddin & Sa'diyah, 2024).

4. Results and Discussions

4.1 Define Stage: Needs Analysis

Observation and interviews with the fifth-grade teacher confirmed that instruction on Indonesian ethnic and cultural diversity was dominated by lecture, question-and-answer exchange, and reliance on the prescribed textbook, supplemented occasionally by the whiteboard, textbook illustrations, and the LCD projector. The teacher reported that the breadth of the content, which spans ethnic groups, traditional houses, garments, regional dances, musical instruments, and local languages across the archipelago, made it difficult for learners to associate each region with its cultural markers, and that comprehension and achievement were correspondingly incomplete. The teacher further observed that learners responded most strongly to activity, colour, imagery, and media they could handle directly, and that attention declined when lessons consisted only of oral explanation and reading. No purpose-built interactive medium for the diversity topic was available at the school.

Observation of the learners produced a complementary picture. Curiosity and enthusiasm were high when visual media or educational games were used, and low when instruction was confined to lecture and textbook. Learners themselves reported that they understood material more readily when it was accompanied by images, attractive colour, games, and group activity, and that the diversity topic was difficult because it required memorising many names of ethnic groups, houses, garments, and dances. Together these findings specified the required characteristics of the medium: an attractive visual presentation built on Indonesian cultural illustration, operation simple enough to need no complex instruction, concise and clearly organised content, opportunity for active use through spinning and answering, and a capacity to sustain curiosity and motivation.

4.2 Design Stage: Product Specification

The medium was designed as an interactive double-spinner disk. The base disk carries a map of Indonesia divided by region, surrounded by illustrations of regional culture including traditional houses, garments, dances, foods, and musical instruments. An upper disk carries a window that reveals a segment of the base disk when rotated, so that a specific cultural detail is exposed one at a time. A central axis functions as the rotary pivot, a pointer directs attention to a designated region, and an accompanying teacher guide sets out operating instructions, lesson steps, and sample questions and activities. The disk diameter was fixed at thirty to forty centimetres, which is large enough for classical and group use and legible from across the classroom.

Structural material was thick adhesive-backed cardboard finished with glossy lamination, chosen so that the product would be durable, safe, and ergonomic under repeated manipulation by children. Colour coding distinguishes island groups, and iconic cultural imagery is paired with short explanatory text so that learners grasp the essential point without being burdened by lengthy exposition. Content was aligned with the prescribed competencies for fifth-grade social studies and organised to integrate character values of tolerance, unity, mutual respect, and love of country alongside the cognitive content. The design stage concluded with a complete blueprint covering pedagogical, visual, technical, and evaluative aspects, which then governed production in the Develop stage.

4.3 Develop Stage: Validation and Trials

4.3.1 Expert Validation

The prototype and its supporting instruments were validated by five expert panels covering material, language, non-test instruments, test instruments, and media, composed as set out in Section 3.5. Aggregate results are presented in Table 1. Because the number of raters per domain varied, and in some domains comprised a single expert, the percentages reported below are best read as expert judgements of feasibility rather than as agreement-based indices of content validity.

Table 1. Aggregate expert validation of the Magic Disk medium and instruments

No	Validation component	Total score	Percentage	Criterion
1	Material	92/100	92.00%	Very feasible
2	Language	69/80	86.25%	Very feasible
3	Non-test instrument	67/80	83.75%	Very feasible
4	Test instrument	63/80	78.75%	Feasible
5	Media	63/80	78.75%	Feasible
Overall mean			83.90%	Very feasible

Table 1 shows that the medium and its instruments obtained an overall mean of 83.90%, which places the developed product in the very feasible category for supporting social studies instruction on Indonesian ethnic and cultural diversity. The material domain recorded the highest score at 92.00% and the test instrument and media domains the lowest at 78.75%, both still within the feasible range.

Disaggregated results for the media panel are reported in Table 2. Validation here addressed visual presentation, the mechanical design of the rotating disk, usability, physical interactivity, and the structural reliability of the laminated cardboard.

Table 2. Detailed results of media expert validation

No	Assessed aspect	Total score	Mean	Percentage	Criterion
1	Visual presentation	12	3.00	75.00%	Feasible
2	Technical construction	17	3.40	85.00%	Very feasible
3	Interactivity of rotary mechanism	16	3.00	80.00%	Feasible
4	Conformity with the material	9	3.00	75.00%	Feasible
5	Instructional usefulness	9	3.00	75.00%	Feasible
Overall		63	3.15	78.75%	Feasible

Table 2 shows a mean rating of 3.15 and a feasibility percentage of 78.75%. Technical construction attracted the highest rating at 85.00%, indicating that the laminated cardboard design was judged sturdy, precise in rotation, and safe for children, while the rotary mechanism was rated 80.00% for responsiveness in presenting regional information. Visual presentation, conformity with the material, and instructional usefulness each received 75.00%, which identified visual refinement as the principal target for revision.

Table 3. Detailed results of material expert validation

No	Assessed aspect	Total score	Mean	Percentage	Criterion
1	Alignment of material with the curriculum	24	4.80	96.00%	Very feasible
2	Accuracy of cultural diversity concepts	23	4.60	92.00%	Very feasible
3	Depth and breadth of material	22	4.40	88.00%	Very feasible
4	Connection with real life	23	4.60	92.00%	Very feasible
Overall		92	4.60	92.00%	Very feasible

Table 3 shows that the material domain reached 92.00% with a mean of 4.60. Curricular alignment recorded the highest value at 96.00%, confirming that the content embedded in the disk corresponds closely to the prescribed fifth-grade learning outcomes, while conceptual accuracy and contextual relevance each reached 92.00%. This confirms that the cultural information carried by the medium is accurate, coherently sequenced, and free of misconception.

Linguistic validation examined the terminology of regional names, vocabulary choice, and sentence structure printed on the disk, with attention to readability for learners aged ten to eleven and to the avoidance of ambiguity. Results appear in Table 4.

Table 4. Detailed results of language expert validation

No	Assessed aspect	Total score	Mean	Percentage	Criterion
1	Suitability of language for learners	16	4.00	100.00%	Very feasible
2	Readability of text on the medium	16	4.00	100.00%	Very feasible
3	Structure and language conventions	12	3.00	75.00%	Feasible
4	Clarity of cultural information	12	3.00	75.00%	Feasible
5	Consistency and effectiveness of language	13	3.25	81.25%	Very feasible
Overall		69	3.45	86.25%	Very feasible

Table 4 shows an overall mean of 3.45 and a percentage of 86.25%. Suitability of language and readability both attained the maximum value of 100.00%, indicating that the explanatory sentences on the disk are communicative and appropriate to the cognitive development of learners aged ten to eleven. Structure and conventions together with clarity of cultural information were rated 75.00%, which prompted minor editing of phrasing before implementation. Validation of the data collection instruments themselves produced 83.75% for the non-test instruments, comprising the learner and teacher response questionnaires and the observation sheet, and 78.75% for the achievement test items. Both results fall within the acceptable range, the former in the very feasible and the latter in the feasible category, so the instruments were retained with minor adjustments to item wording.

4.3.2 User Trials

One-to-one evaluation involved three learners of differing ability, with each learner operating the medium under close observation of tactile response and initial comprehension of the instructions. The small-group trial extended this to ten randomly selected learners in order to examine operational practicality and the social dynamics of collaborative use. Results of both rounds are summarised in Table 5.

Table 5. Results of the one to one and small group trials

No	Assessed aspect	One-to-one (n = 3)	Small group (n = 10)	Category
1	Ease of use	91.67%	91.67%	Very good
2	Visual appearance and design	96.67%	94.58%	Very good
3	Content and material	91.67%	92.50%	Very good

No	Assessed aspect	One-to-one (n = 3)	Small group (n = 10)	Category
4	Motivation and engagement	95.00%	93.75%	Very good
	Overall	93.75%	93.12%	Very good

Table 5 shows overall satisfaction of 93.75% in the one-to-one evaluation and 93.12% in the small-group trial, both in the very good category. Visual appearance recorded the highest rating in both rounds, confirming that the combination of colour and illustrations of garments and traditional houses was compelling for the age group, while motivation and engagement remained above 93% throughout, indicating that learners were willing to spin the disk repeatedly in order to match ethnic groups with their provinces of origin. Qualitative comments produced two revisions: the central hinge was loosened so that the double cardboard rotation became smoother, and the contrast of the printed text was sharpened.

4.3.3 Field Trial

The revised product was implemented with twenty-four fifth-grade learners under normal classroom conditions. Achievement was measured by pretest and posttest and analysed using the normalised gain. Results appear in Table 6.

Table 6. Pretest, posttest, and normalised gain in the field trial (n = 24)

Evaluation parameter	Mean score	Gain	N-gain	Effectiveness category
Pretest	58.50	26.25	0.63	Moderate
Posttest	84.75	-	-	

Table 6 shows that the class mean rose from 58.50 at pretest to 84.75 at posttest, an absolute gain of 26.25 points and a normalised gain of 0.63, which falls in the moderate category and approaches the boundary of the high category at 0.70. The Develop stage therefore established the medium as very feasible, highly practical, and sufficiently effective for full implementation.

4.4 Disseminate Stage: Full Implementation and Effectiveness

Table 7. Descriptive statistics of the pretest and posttest (N = 30)

Statistic	Pretest	Posttest
Number of learners	30	30
Highest score	95.50	96.40
Lowest score	23.60	65.50
Class mean	61.64	84.70
Standard deviation	19.11	6.59
Minimum mastery criterion	70	70

Table 7 shows that before treatment the class mean of 61.64 lay below the minimum mastery criterion of 70 set by the *madrasah*, with scores ranging from 23.60 to 95.50 and a standard deviation of 19.11 that signals a wide dispersion of prior knowledge. After treatment the mean rose to 84.70, comfortably above the mastery criterion, the lowest score rose from 23.60 to 65.50, and the standard deviation contracted to 6.59.

Table 8. Classical normalised gain analysis

Pretest mean	Posttest mean	Gain	N-gain (g)	Effectiveness category
61.64	84.70	23.06	0.60	Moderate

Table 8 shows a classical normalised gain of 0.60, situated in the moderate category. The absolute increase of 23.06 points corresponds to a relative improvement of 37.41% over the initial condition. Since the improvement was measured within a single group, it is reported here as a change observed

in association with use of the rotating disk rather than as retention attributable to the medium alone; the design cannot separate the contribution of the visualisation from that of the additional instructional time, the novelty of the activity, or the repetition of testing.

Table 9. Learner and teacher responses to the Magic Disk medium

No	Assessed aspect	Learners (n = 30)	Teacher (n = 1)
1	Ease of use	92.50%	68.75%
2	Visual appearance and design	95.50%	–
3	Content and curricular conformity	93.17%	100.00%
4	Motivation, engagement, and instructional effectiveness	94.17%	100.00%
5	Continuity of future use	–	100.00%
Overall		93.83%	91.07%

Table 9 shows that learners rated the medium at 93.83% overall, with visual appearance highest at 95.50%, followed by motivation and engagement at 94.17%, content at 93.17%, and ease of use at 92.50%, all within the very good category. The classroom teacher rated the medium at 91.07% overall, awarding the maximum value to curricular conformity, classroom effectiveness, and willingness to reuse the medium in the following academic year. Ease of use was rated 68.75% by the teacher, still within the good category, accompanied by a recommendation that the central hinge be loosened further in subsequent production runs.

Table 10. Paired-sample t-test results

Tested data	t-value	df	Sig. (2-tailed)	Decision
Pretest – posttest	6.359	29	0.000	H_0 rejected

Table 10 shows a calculated t-value of 6.359 at 29 degrees of freedom with a two-tailed significance below 0.001. The mean difference of 23.06 points has a 95% confidence interval of approximately 15.65 to 30.48 points and corresponds to a paired effect size of $d = 1.16$, which is large by conventional benchmarks. The null hypothesis is therefore rejected and the alternative hypothesis accepted: the difference in learning outcomes before and after use of the Magic Disk is statistically significant and not attributable to sampling variation. The test establishes the reliability of the within-group change only. In the absence of a control class it does not isolate the medium as the cause of that change, because maturation, the testing effect arising from repeated exposure to similar items, events outside the classroom, and regression towards the mean from an unusually low pretest remain uncontrolled (Marsden & Torgerson, 2012). The result is accordingly interpreted as an improvement associated with the use of the medium, and a quasi-experimental design with an equivalent control class is required before a causal claim can be sustained.

Dissemination itself was carried out through demonstration and modelling of the medium in a live social studies lesson before the fifth-grade teacher and colleagues teaching the social studies cluster. A ready-to-use laminated unit together with its technical operating guide was formally handed over to the madrasah authorities to secure continuity of use.

4.5 Discussion

The findings answer both research questions. On the first, the Define stage confirmed that social studies instruction on the diversity topic had been conventional, lecture-dominated, and textbook-dependent, with no visual or manipulative aid available. The consequence was measurable: prior knowledge was low, with a pretest mean of 61.64 below the mastery criterion of 70, and the dispersion of ability was wide, with a standard deviation of 19.11. This corroborates reports that reliance on textbooks alone weakens conceptual understanding in elementary social studies (Karima, Erni, Febriani, Handini, Palupi, Lestari, Cantika, Ramadhan, & Alitasari, 2025) and that the absence of varied media depresses engagement and concentration (Puspitasari, Sari, Putri, & Wuryani, 2018).

On the second question, the evidence for feasibility and effectiveness is consistent across sources. Aggregate expert validation of 83.90% placed the product in the very feasible category, staged user trials returned 93.75% and 93.12%, and the response questionnaires returned 93.83% from learners and 91.07% from the teacher. Improvement in learning outcomes was registered by three convergent indicators: a rise in the class mean from 61.64 to 84.70, equivalent to a relative gain of 37.41%; a normalised gain of 0.60 in the moderate category; and a paired-sample t-test result of $t = 6.359$ with $p < 0.001$ and $d = 1.16$, which excludes sampling variation as an explanation of the change although it does not, on its own, establish the medium as its cause.

The contraction of the standard deviation from 19.11 to 6.59 is the most striking feature of the descriptive data. Read at face value it suggests that attainment was redistributed more evenly rather than simply raised, with the medium operating as a bridge for learners who had previously struggled instead of an advantage confined to high achievers, a reading consistent with evidence that concrete media improve conceptual understanding among elementary learners of varying ability ([Mustaqimah, & Astuti, 2024](#); [Utami, 2022](#)). Two alternative explanations must be entertained before that reading is accepted. The first is a ceiling effect: with a maximum of 100 and a posttest mean of 84.70, the headroom available to the strongest learners was small, so dispersion would contract mechanically even if every learner had gained equally in ability. The second is regression towards the mean, which is expected whenever a group is measured twice on a fallible instrument and the first measurement is unusually low, as a pretest mean of 61.64 with a standard deviation of 19.11 was here; extreme scores at pretest tend to move towards the centre at posttest independently of any treatment ([Barnett, van der Pols, & Dobson, 2005](#)). The present data cannot adjudicate between these accounts. A control class measured on the same schedule, or an achievement test with a higher ceiling, would be needed to establish that the narrowing reflects a genuine equalisation of learning rather than a property of the measurement.

The placement of the normalised gain in the moderate rather than the high category is interpretable in terms of cognitive load. The disk delivers information one sector at a time, which restricts the volume of new material in working memory at any moment while preserving the breadth of the topic. Improvement was therefore substantial and stable without evidence of overload, a pattern consistent with the concrete operational characteristics of learners aged ten to eleven and with the principle of fading from concrete to abstract representation as competence develops ([Fyfe, McNeil, Son, & Goldstone, 2014](#)). The mechanism through which the gain was produced is best described as the substitution of kinaesthetic and visual activity for abstract memorisation: in spinning the disk, learners actively matched regions of origin with garments, dances, and traditional houses, and this active matching reinforced long-term retention ([Fransiska, Suarni, & Margunayasa, 2024](#); [Qur, Susanti, Lailiyah, & Fendiyanto, 2024](#)).

Direct comparison with the two earlier disk studies is instructive. [Galuh \(2016\)](#) reported a calculated t of 4.777 against a critical value of 2.052 for a Magic Disk applied to the same content domain, whereas the present study obtained 6.359 against a critical value of 2.045 at 29 degrees of freedom, a larger margin over the critical value although the two designs differ in sample size and item difficulty and the comparison is therefore indicative rather than decisive. ([Galuh, 2016](#)) required three instructional cycles to move a class mean from 57.11 with 16% mastery to 82.57 with 84% mastery, a total rise of 25.46 points, while the present implementation recorded a rise of 23.06 points from a similar starting level within a single cycle. Convergence on a rise of roughly twenty-three to twenty-six points across three independent implementations of the same format is the more informative result, since it suggests a ceiling on what the format delivers rather than an effect peculiar to one classroom. Three mechanisms plausibly account for that regularity. Cognitive load theory explains why the disk outperforms a textbook page listing the same content: exposing one sector at a time reduces element interactivity, so the learner integrates a province with its house, garment, and dance as a single chunk rather than holding thirty pairings in working memory at once ([Mayer, & Moreno, 2003](#); [Sweller, van Merriënboer, & Paas, 2019](#)).

Dual coding theory explains why the pairing endures: each sector supplies a pictorial and a verbal trace of the same referent, and two retrieval routes are more robust than one (Clark, & Paivio, 1991; Mayer, 2017). Gamification explains the engagement that makes repeated exposure tolerable: because the stopping position is unpredictable, each spin carries an element of anticipation, which sustains voluntary repetition of what is in substance a drill (Sailer, & Homner, 2020; Ryan, & Deci, 2000). The present study extends the earlier work in three procedural respects, in that it documents a complete 4D cycle with validation across four domains of expertise, reports staged trials from one-to-one evaluation through small-group and field trial to full implementation, and situates the development in a madrasah ibtidaiyah where the diversity topic carries additional civic and religious significance. The teacher's maximum rating for willingness to reuse the medium further suggests that the resource is sustainable in practice and not merely viable under research conditions.

The lower ratings recorded for visual presentation by the media expert and for ease of use by the teacher deserve attention because they identify the same underlying issue from two directions. The mechanical tolerance of the central hinge governs how smoothly the double cardboard disks rotate, and it was the one aspect that attracted critical comment at every stage of evaluation. This convergence indicates that refinement of the pivot assembly, rather than of the content or the visual design, is the priority for any subsequent production of the medium.

5. Conclusions

5.1 Conclusion

This study set out to develop a Magic Disk learning medium for the topic of Indonesian ethnic and cultural diversity, to determine its feasibility, and to analyse the change in learning outcomes accompanying its use among fifth-grade students at MI Persis 72 Gunung Buntung. Both objectives were met. Regarding the initial condition of instruction, social studies teaching on the diversity topic was found to be conventional, dominated by one-way lecture, and heavily dependent on the prescribed textbook, with no visual or manipulative aid in use; prior knowledge was correspondingly low, with a pretest mean of 61.64 against a mastery criterion of 70 and a standard deviation of 19.11 indicating a wide gap in understanding between learners.

Regarding the developed product, the Magic Disk was declared very feasible with an aggregate expert validation score of 83.90%, comprising 92.00% for material, 86.25% for language, 83.75% for the non-test instruments, and 78.75% each for the test instruments and the media. Practicality was confirmed by staged trials returning 93.75% in one-to-one evaluation and 93.12% in the small-group trial, and by response questionnaires returning 93.83% from learners and 91.07% from the classroom teacher, all within the very good category.

Regarding learning outcomes, the class mean rose from 61.64 at pretest to 84.70 at posttest, a relative improvement of 37.41%, while the standard deviation fell from 19.11 to 6.59. The paired-sample t-test produced a calculated value of 6.359 with a significance below 0.001 and a paired effect size of 1.16, so the null hypothesis was rejected and the alternative hypothesis accepted. The normalised gain of 0.60 places the improvement in the moderate category. Because the improvement was measured within a single group, it is reported as associated with rather than caused by the medium: the design does not exclude maturation, the testing effect, or regression towards the mean, and the contraction in dispersion may in part reflect a ceiling effect. Taken together, the findings establish that the Magic Disk is feasible and practical, and that its classroom use was accompanied by a substantial and statistically reliable improvement in attainment on the diversity topic. A quasi-experimental study with a control class is the necessary next step before the medium can be described as effective in the causal sense.

5.2 Research Limitations

Several limitations qualify these conclusions. The study used a one-group pretest–posttest design without a control class, so the observed improvement cannot be attributed to the medium to the exclusion of maturation, testing effects, history, regression towards the mean, or teacher enthusiasm during the intervention. The four evaluation stages were drawn from a single fifth-grade cohort and

were therefore not independent, so learners entering the full implementation had already encountered the medium and its associated items. The sample was confined to thirty learners in a single madrasah in Serang Regency, which restricts the generalisability of the findings to other institutions, regions, and school types. The treatment period spanned only two to three weeks, so the durability of the observed retention over a longer horizon remains untested. Coverage was limited to a single topic within the fifth-grade social studies curriculum, and measurement concentrated on the cognitive domain, leaving affective and psychomotor outcomes assessed only through response questionnaires rather than dedicated instruments. Content validity rested on a small validation panel, which limits the stability of the feasibility percentages and precluded the computation of inter-rater agreement coefficients. Finally, validation in the media and test-instrument domains reached the feasible rather than the very feasible category, and the mechanical tolerance of the central pivot attracted recurrent critical comment, indicating that the physical product had not yet reached its optimum specification at the time of testing.

5.3 Suggestions and Directions for Future Research

Teachers are encouraged to integrate manipulative interactive media of this kind into social studies instruction on a regular basis, since such media offer a workable alternative to monotonous lecture delivery and sustain intrinsic motivation during concept discovery. Madrasah authorities are advised to facilitate reproduction and archiving of the medium together with its operating guide in the teaching aid room, so that the resource can be distributed and used sustainably by other teachers in subsequent academic years.

For future research, four directions are recommended. First, the design should be replaced by a quasi-experiment with a non-equivalent control class taught the same content without the medium, supplemented where feasible by a delayed posttest and by independent evaluation stages, so that the effect of the medium can be isolated from maturation and testing effects and its durability assessed. Second, the sample should be widened across several schools and regions, including public elementary schools, and the validation panel enlarged to at least two independent experts per domain so that agreement indices such as Aiken V can be reported alongside feasibility percentages. Third, the mechanical specification of the product should be refined, particularly by loosening the central pivot so that rotation of the double cardboard disks becomes lighter and more ergonomic for children's fingers. Fourth, the rotary concept should be extended to other social studies content requiring high spatial and cultural visualisation, and its integration with digital extensions through quick response codes should be investigated so that the medium can function within a blended learning arrangement.

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Author Contributions

SLJ was responsible for conceptualisation, study design, development of the Magic Disk medium, data collection, data analysis, and drafting of the manuscript. AMO contributed to study design, supervision, methodological review, critical revision of the manuscript, and final approval of the version to be published. Both authors have read and agreed to the submitted version of the manuscript and accept accountability for all aspects of the work.

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