Proceedings of CONF-MLA 2026 Symposium: Intelligent Systems and Automation: AI Models, IoT, and Robotic Algorithms
DOI: 10.54254/2755-2721/2026.LD38465

Designing a Personalized Traditional Mongolian Learning System for Children in Inner Mongolia

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Abstract. Limited access to Mongolian instruction at home can restrict opportunities for children in Inner Mongolia to develop beginning vocabulary and traditional-script recognition. This research proposal presents a small browser-based learning system that combines teacher-reviewed vocabulary, pronunciation recordings, images, short contextual examples, and correctly rendered vertical Mongolian text. A transparent rule set selects practice items from first-attempt accuracy that hint use and review dates rather than from a trained prediction model. The proposed study begins with interviews involving teachers and parents and continues with technical and script rendering tests, and concludes with a two-week feasibility trial if institutional approval, parental permission, and child assent are obtained. The primary outcome is seven-day delayed recognition of taught words. Secondary outcomes include audio-to-word matching, completion, requests for help, and interface usability. Expected findings concern feasibility and short-term retention rather than general fluency or language preservation. The design also limits data collection, preserves teacher oversight, and documents the constraints of a small sample.

Keywords: traditional Mongolian script, children, personalized learning, spaced practice, multilingual education

1. Introduction

Traditional Mongolian remains culturally and educationally significant in Inner Mongolia, yet access to the language differs across homes and schools. Residence in a historically Mongolian-speaking region does not ensure regular exposure, adult language support, or opportunities to read the traditional script. UNESCO guidance identifies multilingual education as an important basis for inclusion and learning because instruction is more accessible when learners can engage with languages they understand [1]. This principle supports closer attention to children who have limited opportunities to study Mongolian outside formal lessons.

The proposed project addresses this access problem through a personalized mobile or browser-based learning system for beginning learners. Its long-term educational purpose is to support basic communication, including greetings, self-introductions, and everyday needs, while introducing the traditional Mongolian script used in China. The initial research version has a narrower scope: it teaches a limited set of common words and measures recognition of meanings, printed forms, and associated audio after a delay. A short vocabulary study cannot demonstrate conversational fluency,

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cultural preservation, or long-term language use; those outcomes require separate longitudinal research.

Learners may differ in age, reading ability, spoken-language exposure, and access to adult assistance. Within this proposal, personalization refers to changes in task selection and review timing based on observed performance. It does not assign a fixed learning style or replace instruction by qualified educators. Teachers approve lesson content, review progress, and retain authority to override system recommendations. The central question is whether this limited and transparent adaptation improves delayed recognition when compared with a fixed practice order using the same content and study time.

2. Background and literature review

2.1. Traditional Mongolian script and multilingual education

Traditional Mongolian is written vertically, and letter forms can change according to position and neighboring letters. Teneg examines the continued use of the script in China and efforts to reintroduce it in Mongolia [2]. These features will affect both instruction and software design because complete connected words must appear in the correct direction rather than as disconnected substitute characters. The World Wide Web Consortium guidance describes vertical direction, column order, line breaking, selection, and related interaction requirements [3]. Accurate rendering is therefore a necessary technical condition, although correct display alone does not establish learning effectiveness.

Language instruction also depends on local conditions. Global multilingual-education guidance emphasizes the value of culturally relevant materials, teacher preparation, community participation, and sustained implementation rather than a single technological intervention [1]. Consequently, the proposed needs assessment examines home language exposure, reading experience, device access, and available adult support. Children who share an age group or ethnic background cannot be treated as having identical learning experiences.

2.2. Adaptive learning and language education

Adaptive learning systems are designed to match instruction to individual performance, but implementation and evaluation quality vary. Kabudi et al. mapped 147 studies of artificial intelligence in adaptive learning and identified a gap between proposed functions and systems that were implemented and tested [4]. Qiao et al. reviewed 30 studies of artificial intelligence for language learning and reported limited attention to adaptive personalization [5], together with weaknesses in research design. Much of the reviewed work involved university students, English learning, and speaking or writing tasks, so the findings cannot be transferred directly to traditional Mongolian learning among children.

A trained prediction model is therefore excluded from the first prototype. The proposed rule-based design exposes each selection criterion to teachers, parents, and researchers. An incorrect response or hint use produces an earlier review, whereas independent correct responses across separate sessions lengthen the interval. This design permits direct inspection of the decision process and supports a controlled comparison between personalized and fixed-order practice.

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2.3. Practice scheduling and multimedia

Practice distributed across time can strengthen second-language learning, although no single schedule fits every context. Kim and Webb synthesized 48 experiments and found an overall advantage for spaced second-language practice [6]. The effect varied by learning and testing conditions, while equal and expanding intervals produced statistically similar results in the combined analysis. The proposed one-, three-, seven-, and fourteen-day intervals are therefore testable design values rather than established values for the target population.

Digital elements require a defined instructional function. Furenes et al. found that transferring children's reading from paper to a screen did not automatically improve comprehension [7]; digital enhancements were most useful when they supported the text rather than diverted attention. Webb et al. also found that incidental vocabulary learning varied with learner characteristics [8], materials, activities, and measurement. Accordingly, images and audio in the prototype are attached to specific vocabulary tasks, while decorative animation, public rankings, and unrelated game features are excluded.

Technology selection also requires attention to access, equity, and educational purpose. The 2023 Global Education Monitoring Report concludes that educational technology should respond to learner needs and local conditions rather than be treated as an automatic solution [9]. This position supports short-session low-device requirements, teacher-reviewed content, and a feasibility study before wider implementation.

3. Research questions

The study addresses the three questions summarized in Table 1. The questions separate learning outcomes, usability, and contextual requirements so that a positive result in one area is not treated as proof of success in all areas.

Table 1. Research questions and analytical focus

Question	Research question	Primary evidence
RQ1	Compared with a fixed practice order, does a rule-based personalized sequence improve delayed recognition of taught traditional Mongolian words?	Baseline, immediate posttest, and seven-day delayed test scores
RQ2	Can children and teachers use the interface and understand the stated reasons for task recommendations?	Completion records, requests for help, observations, and short interviews
RQ3	Which practical requirements do teachers and parents identify for children with limited Mongolian support at home?	Semi-structured interviews and supervised observations

Table 1 links each question to a distinct evidence source. RQ1 tests delayed recognition, RQ2 examines usability and explanation quality, and RQ3 guides local content and access decisions. This separation prevents interface satisfaction or teacher approval from being interpreted as direct evidence of vocabulary retention.

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4. Proposed system design

4.1. Scope and learners

The initial prototype focuses on beginning recognition of traditional Mongolian and approximately forty everyday words. The tentative age range is six to twelve, with descriptive results separated into ages six to eight and nine to twelve when sample size permits. Spoken language exposure and baseline reading performance are recorded separately. Automatic pronunciation scoring, open-ended chatbot conversation, and a complete school curriculum fall outside the first version because unverified automated feedback could be mistaken for expert evaluation.

4.2. Lesson content and interface

The lesson library contains teacher-selected words from familiar topics such as family, school, animals, food, colors, and numbers. Each entry includes traditional Mongolian spelling, a concise meaning, a licensed image, a teacher-approved recording, and a short contextual example. Two educators proficient in Mongolian review spelling, audio, cultural suitability, and age appropriateness before participant use. The spoken variety represented in each recording is documented.

Each lesson introduces only a small number of items. Learners hear a word, view its meaning and image, and then complete picture-to-word and audio-to-word matching tasks. A hint first repeats task-relevant information and then presents a worked example when necessary. The original first attempt remains in the research record after a second attempt. Traditional Mongolian text is stored as searchable Unicode and displayed vertically in columns progressing from left to right [3]. Need assessment findings determine whether navigation labels use Chinese text, simple icons, or both.

Rendering is verified across target browsers and devices. The test set includes contextual letter forms, punctuation, line wrapping, text selection, and labels that combine scripts. A proficient reviewer compares screenshots and copied text with approved examples because valid Unicode text can still appear incorrectly when fonts, browsers, or layout engines handle the script inconsistently.

4.3. Architecture and data storage

The prototype uses a browser interface, a small application layer, and a relational database. Flask and SQLite are suitable for local development, although final deployment depends on school access requirements. Content approval remains separate from learning-event processing so that learner responses cannot alter the spelling or audio designated as the instructional standard.

Figure 1 presents the proposed architecture and the direction of information flow. The upper path converts findings from teachers and parents into reviewed lesson material and then delivers the material through the child interface. The lower loop records responses, applies review rules, stores progress, and returns the next task without changing approved lesson content.

As shown in Figure 1, needs assessment and lesson approval occur before learner interaction, while recommendation rules operate only on response history and review dates. The database separates content, pseudonymous learner profiles, and response events, and review schedules. Response records include the item, task type, first-attempt accuracy, hint use, and timestamp. Review records include the next due date and the reason for selection. Event identifiers prevent duplicate submissions after network retries, and teacher accounts display only assigned learners.

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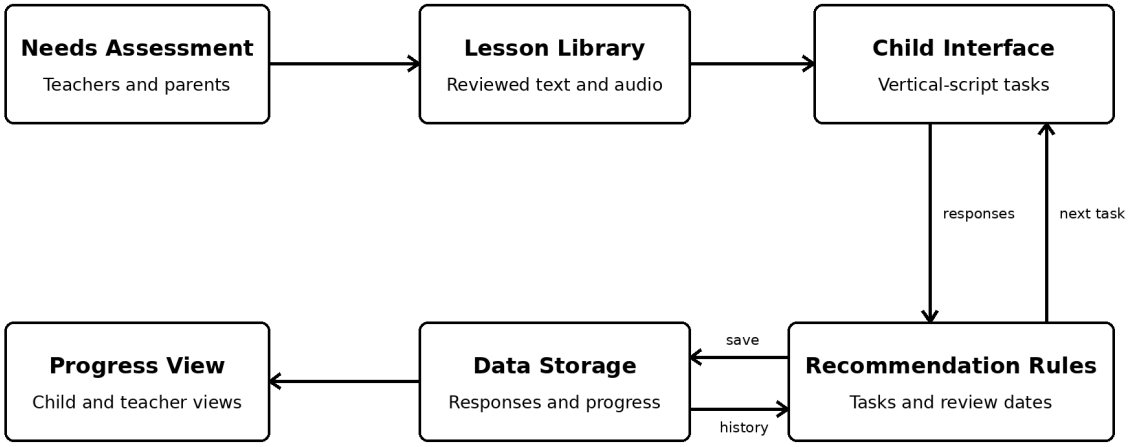


Figure 1. Proposed system architecture and information flow. Source: proposed system design (photo/picture credit: original)

4.4. Transparent recommendation rules

A short diagnostic activity identifies words already recognized without hints. New learners begin with teacher-selected introductory items. After each response, the system updates the item's practice status. Response time can indicate usability problems, but it does not reduce an ability estimate because reading speed and device experience differ among children.

An incorrect response triggers a brief explanation. The item returns after at least two different items and becomes due again during the next learning session. A word answered correctly only after a hint is also due the next day. Independent correct answers across separate sessions move the item through proposed intervals of one, three, seven, and fourteen days; an error resets the interval sequence. At the beginning of a session, overdue reviews appear before unlocked new items in the teacher-defined course order. Each session introduces no more than three new items and lasts no more than ten minutes.

The interface states the reason for each recommendation in concise language, for example, "review due" or "additional practice after a hint." Teachers can override a selection, and the system records the override. Technical tests cover missed sessions, repeated errors, empty learning histories, and completion of all available content.

4.5. Progress information

Learners see completed lessons and a short list of words due for review. Public rankings are excluded. Teachers see first-attempt accuracy by task type, hint use, practice dates, and overdue items. Activity counts remain separate from outcome-test scores because practice behavior does not represent complete language ability. Missing records are reported as missing information rather than converted to a score of zero.

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5. Proposed research method

5.1. Needs assessment

After school approval and informed consent, the needs assessment includes approximately three to five Mongolian teachers and five to eight parents. Semi-structured interviews address children's spoken-language needs, reading difficulties, home language use, device access, adult support, and useful progress information. Short observations under teacher supervision examine responses to sample lessons on paper and on a screen. Repeated themes are summarized, and participating teachers review the summary for consistency with the interview record. Because convenience sampling limits representativeness, the findings guide prototype design but do not represent every family in Inner Mongolia.

5.2. Technical testing

Technical testing occurs before participant recruitment. Teacher-approved rendering examples are checked across the selected browsers and devices. Unit tests verify schedule updates, duplicate-event handling, and teacher access restrictions. Synthetic learning histories represent repeated correct responses, repeated errors, missed sessions, and mixed performance. These artificial records are labeled as test data and cannot support claims about learning effectiveness. The technical report records failed cases as well as successful cases.

5.3. Feasibility trial

If institutional approval and recruitment conditions are met, the feasibility trial includes approximately thirty to forty children. This number is a practical target rather than the product of a formal power analysis. Within age bands and broad baseline-reading categories, participants are randomly assigned to personalized practice or fixed-order practice. Both groups receive the same interface, content, hints, session duration, and number of sessions; only task selection and review timing differ. Teacher assistance and study outside the project are recorded.

The intervention lasts two weeks and includes eight ten-minute sessions. Sixteen words from the lesson library form a common test set. At the start of each session, both groups receive the same introduction to two new words and then practice previously introduced words. The personalized group follows the rule system described above, while the comparison group cycles through introduced words in a predetermined order unrelated to individual responses. This restriction keeps first exposure and total study time comparable between groups.

The baseline test, immediate posttest, and seven-day delayed test use parallel forms. Each form includes the same target words but changes item order and answer choice order to reduce memory for the test layout. The primary outcome is delayed matching of printed traditional Mongolian words to their meanings. Secondary outcomes include audio-to-word matching, immediate scores, completion, and requests for assistance. Outcome tests provide no feedback. Teacher comments and brief child-appropriate interviews identify unclear controls. The fourteen-day review interval receives technical testing only because the trial ends before a full instructional test of that interval is possible.

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5.4. Analysis plan

The analysis compares delayed-test scores while accounting for baseline performance and the factors used during stratified assignment. Reported statistics include group means, an adjusted group difference, a confidence interval, attendance, and the number of missing delayed tests. Estimates are interpreted cautiously because of the small sample. Patterns by age group or baseline category are treated as exploratory. A higher score in the personalized group would apply only to recognition of the taught words under the study conditions; it would not demonstrate general fluency or a long-term effect on cultural participation. If participant recruitment is not possible, the final report is limited to the design process and technical evaluation.

6. Ethical considerations

Research involving children requires approval from the relevant institution and school, informed permission from a parent or guardian, and age-appropriate assent from each child. Participation is voluntary, unrelated to school grades, and may end without penalty. The research database does not collect names, exact home addresses, or voice recordings. Consent records are stored separately with restricted access, and the study protocol specifies access permissions and deletion dates for identifying links.

Privacy protections also apply to software operation. Participant information is not transferred to a public generative artificial intelligence service. UNESCO guidance recommends human-centered, age-appropriate design and explicit protection of data privacy in educational uses of generative artificial intelligence [10]. Although the prototype does not use a generative model, the same principles support data minimization, teacher oversight, and clear limits on automated recommendations.

Progress displays avoid public scores and labels that characterize a child as weak or incapable. Recommendations describe recent learning events, such as hint use, instead of making permanent judgments about ability. This approach also reflects broader evidence that educational technology can create privacy and equity risks when implementation is not governed by clear educational goals and safeguards [9].

7. Limitations

Several limitations constrain interpretation. First, the target sample is small and based on practical access, so findings may not transfer to other schools, ages, spoken varieties, or levels of Mongolian experience. Second, a two-week trial measures only short-term vocabulary recognition and delayed retention; it cannot establish conversational development or long-term use. Third, teacher-selected content may strengthen local accuracy but also makes implementation dependent on available reviewers. Fourth, vertical-script performance may differ across devices even after structured testing. Finally, transparent rule-based scheduling may fail to detect patterns that a larger validated model could identify. These limitations require narrow claims and detailed documentation of the prototype and study conditions.

8. Conclusion

The proposal defines a limited and testable learning system for children beginning traditional Mongolian. Its main components are teacher-reviewed lessons, correct vertical text, short

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multimedia tasks, transparent review rules, protected learning records, and interpretable progress information. The planned sequence begins with a local needs assessment, continues through content review and technical testing, and proceeds to a small feasibility trial only after approval and consent requirements are satisfied.

An application cannot independently reverse language loss or replace teaching at home and school. The proposed system instead provides children with limited home support an accessible entry point to basic vocabulary, pronunciation, and traditional-script recognition. Later versions may add guided speaking practice, but such development requires separate measures of pronunciation, independent use, interest, and communication. Maintaining a focused first study allows the project to determine whether the basic design is usable and whether personalized review merits further investigation.

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