

Research Design and Methods for Studying the Speech Competence of Future Surdopedagogues

Maxmudova Oygul Toxirjonovna

Acting Associate Professor, Fergana State University, Uzbekistan

Received: 12 February 2026; **Accepted:** 08 March 2026; **Published:** 31 March 2026

Abstract: Studying the speech competence of future surdopedagogues (specialist teachers working with children who have hearing impairments) requires a well-grounded research design and a purposeful selection of methods. Speech competence is a complex, multicomponent phenomenon that cannot be fully investigated by a single method alone. For this reason, the present study is based on a mixed-methods research design: quantitative methods serve to measure indicators of speech competence and to identify statistical relationships among them, while qualitative methods provide a deep, contextual understanding of the process through which speech competence is formed. Such a mixed approach combines the strengths of both methods and serves a full and profound understanding of complex pedagogical phenomena.

Keywords: Surdopedagogue, interactive methods, pedagogical approach, speech competence.

Introduction: The set of methods applied in the study follows a coherent logical sequence: first, the initial level of speech competence of future surdopedagogues is established through observation and diagnostic tests; the proposed pedagogical model (a program for developing speech competence) is then implemented in practice; and, finally, the effectiveness of the formative experiment's results is evaluated using statistical procedures. Throughout the study, the principle of triangulation is applied: data obtained through one method are confirmed or enriched through another, which increases the reliability of the scientific conclusions [1]. Each method, as adapted to the study of speech competence, is described in detail below.

Observation method

Pedagogical observation is one of the most important and informative methods for studying the speech competence of future surdopedagogues. Observation is a method of determining the state of the phenomenon under investigation through purposeful

and systematic monitoring conducted according to a specific plan [2]. Within the context of speech competence, observation is carried out in two directions: first, observing the future surdopedagogue's own speech pattern and pronunciation quality during practical training sessions; and second, observing his or her behaviour while conducting speech-correctional sessions with children who have hearing impairments.

When conducting observation, it is essential to comply with requirements such as setting a clear objective, regularity, and consistency — otherwise subjective errors may arise [3]. The specialised observation sheet (rubric) used to assess speech competence includes the following parameters: the student's speech tempo and rhythm (whether the pace is measured and comfortable for a hearing-impaired child); accuracy of articulation (whether it provides the visual clarity required for lip-reading); control of voice volume and range; the ability to vary intonation and tone in order to differentiate and convey information; and the ability to combine sign-language elements with oral

speech. Each parameter is rated on a 5-point scale, and inter-rater reliability is subsequently calculated.

Observation results are recorded in special protocols and are subsequently examined through content analysis to identify general trends and problem areas. In this study, the selective type of observation is used: each student is observed in at least three sessions during practicum — at the initial, intermediate, and final stages — which makes it possible to trace the dynamics of speech-competence development. In addition, the sessions are video-recorded and later re-analysed by specialists, which further increases the reliability of the observation data [4]. Data from the observation protocols are converted into quantitative indicators (a scoring system) alongside qualitative analysis, allowing the observation results to be incorporated into statistical analysis.

Questionnaire (survey) method

The questionnaire method involves collecting respondents' opinions and information in written form through a set of systematic questions [5]. In studying speech competence, questionnaires are used for three purposes: a self-assessment questionnaire for future surdopedagogues concerning their own speech competence; an evaluation questionnaire for supervising mentors during practicum; and an evaluation questionnaire on speech-professional competence completed by graduates' workplace supervisors.

Questionnaire items are formulated in both open and closed form. Open-ended questions allow students to freely express their views on their own speech-related difficulties and their efforts at self-improvement, while closed questions yield numerical data suitable for statistical analysis [6]. An example of a closed question is: "Are you able to specifically adapt your articulation for a child with a hearing impairment?" (1 — never, 5 — always). An example of an open question is: "What difficulties do you experience in bringing your own speech to an exemplary standard during training sessions?" Combining both types of questions makes it possible to enrich quantitative indicators through qualitative analysis [7].

When constructing a questionnaire, it is important that the questions be clear, understandable, and linguistically appropriate for the target respondents;

given that speech competence involves specialised terminology, it is recommended that key terms be accompanied by explanations. After a pilot test with a small group, the clarity of the questions is checked [8]. To validate the questionnaires, subject-matter experts — professors of surdopedagogy and practising surdopedagogues — review the instrument (a Content Validity Index is calculated, with $CVI \geq 0.78$ required) [9]. The number of items should not be excessive, as an overly long questionnaire may fatigue respondents and reduce the quality of their answers.

Interview method

The interview method involves collecting information through oral communication with a respondent on questions related to the research topic [10]. In research on speech competence, the interview method serves two main purposes: to examine more deeply the causes of problems identified through observation or test results, and to elicit the student's subjective experience, motivation, and professional self-awareness regarding the development of his or her speech competence.

Interviews are conducted individually, with each student undergoing a 30–45-minute semi-structured interview [11]. The block of interview questions is organised around the following themes: the student's own speech culture and self-monitoring of speech during training sessions; which step he or she would take first when planning a speech-correctional session; and how he or she determines a child's needs after reviewing audiogram results. These questions relate directly to indicators of speech competence and also make it possible to assess the student's reflective thinking. Interview recordings are transcribed, and the main themes are identified through thematic analysis.

In addition to future surdopedagogues, interviews are also conducted with supervising mentors (practicum supervisors at special schools and higher education institutions) and university instructors. By comparing information obtained from these three sources — student, mentor, and instructor — the researcher is able to reach a more complete and multifaceted conclusion regarding the student's speech competence. Researcher responsiveness to respondents' answers, together with further probing during the interview, increases the effectiveness of

the conversation [12]. Interviews yield rich narrative qualitative data on speech competence which, together with quantitative test results, provide a broad and in-depth answer to the research questions posed.

Diagnostic test method

The test method involves measuring participants' knowledge, skills, or psychological characteristics through specially designed test tasks [13]. Three types of diagnostic test are used in this study to assess speech competence.

The first is a written test measuring the quality of theoretical linguistic knowledge, including questions on concepts in phonetics, surdopedagogy, psycholinguistics, and audiology, as well as their application to solving speech-related problems. The items vary in difficulty, combining easy (recall), medium (comprehension and application), and difficult (analysis and synthesis) levels [14].

The second type is a practical-situational test, in which the student is presented with a real surdopedagogical situation (a child's "profile": audiogram, stage of speech development, age) and is asked to draw methodological conclusions and develop an individual speech-correctional plan. This test simultaneously assesses the student's ability to apply theoretical knowledge to practical decision-making [15].

The third type is a speech-sample test, in which the student is asked to produce a five-minute speech sample intended for a child with a particular level of hearing loss (video-recorded). This sample is evaluated by experts using a rubric-based scale covering pronunciation accuracy, speech tempo, articulation, and facial expression.

Tests must be standardised, meaning that the test tasks, instructions, administration conditions, and scoring procedures are applied identically to all respondents [16]. Discrimination — a test's ability to distinguish between stronger and weaker respondents — is an important property. The test includes items of varying difficulty, and the internal consistency of the test data is checked using Cronbach's alpha ($\alpha \geq 0.70$ is considered satisfactory) [17]. When developing test items, each question must correspond to a clearly defined indicator — for example, "knowledge of phonetics" or "the ability to adapt pronunciation for

sign-supported communication" — thereby ensuring construct validity.

Formative experiment

A formative experiment is used in the study to test the effectiveness of the pedagogical model designed to develop speech competence. A formative experiment is a pedagogical intervention aimed at purposefully creating specific pedagogical conditions and studying, under controlled circumstances, the formation of speech competence in students as a result of these conditions [18]. The experimental design proceeds as follows: research participants are divided into an experimental group and a control group. The experimental group undergoes a special model aimed at developing speech competence, while the control group continues with traditional instruction. Both groups undergo the same diagnostic test and observation procedures at the beginning and end of the experiment, following a pre-test/post-test design [19].

The formative experiment is conducted in three stages: the first stage — a diagnostic (ascertaining) experiment, in which the initial level of speech competence of future surdopedagogues is measured and analysed across all five indicators; the second stage — the formative experiment proper, in which the developed speech-competence model is implemented with the experimental group over the course of one semester; and the third stage — a control (final) experiment, in which the changes in speech competence that occurred during the intervention are evaluated using both quantitative and qualitative methods [20]. The model implemented with the experimental group includes the following components: specialised speech-articulation training; exercises combining sign language with oral speech; self-observation of one's own speech through video analysis (reflective exercises); and the planning and defence of exemplary training sessions. The correspondence of these components to the five indicators of speech competence ensures the scientific soundness of the model.

Validity and reliability

Any research instrument — whether a questionnaire or a test — must satisfy scientific requirements. For diagnostic tools measuring speech competence,

questions of validity and reliability are especially important, since these instruments constitute the empirical foundation of the system of indicators [21]. The relevant types of validity are as follows: content validity (whether, in experts' judgement, the content of the test items corresponds to the structure of speech competence); criterion validity (whether test results correlate with an independent criterion); and construct validity (whether the test is logically composed of interrelated components consistent with the theoretical model of speech competence) [22].

To assess content validity, all test items and questionnaire questions are presented to a panel of subject-matter experts (3–5 experienced surdopedagogues and higher-education instructors), who evaluate how well the items correspond to the construct of speech competence. A Content Validity Index (CVI) ≥ 0.78 for each item is the standard requirement [23]. The principal methods used to check reliability are: test–retest reliability (administering the speech-competence test twice, 2–4 weeks apart, and comparing results); internal consistency (Cronbach's alpha, with alpha ≥ 0.70 considered adequate); and inter-rater reliability — the degree of agreement among several experts' ratings of a speech sample (Cohen's Kappa ≥ 0.61) [24].

Inter-rater reliability is particularly important for the speech-sample test, in which a student is video-recorded and his or her speech is evaluated by experts using a rubric-based scale. If three experts observing the same student's speech sample assign markedly different scores, this indicates that the quality of the assessment instrument is low. For this reason, the assessment rubric must be equipped with very precise, operationalised descriptors — for example: "5 points: every word the student pronounces is visually clear for lip-reading, and speech tempo is 2–3 syllables per second; 1 point: many words are not visually clear, and speech tempo is excessively fast." Such precise descriptors minimise disagreement among experts.

Statistical analysis methods

Statistical analysis plays an important role in drawing scientific conclusions from the data collected in the study of speech competence. Statistical methods make it possible to identify patterns in seemingly disordered data, test the significance of differences,

and draw reliable conclusions. The analysis is conducted in two stages: descriptive statistics and inferential statistics [25].

At the descriptive statistics stage, the mean score, median, standard deviation, and distribution characteristics are determined for each indicator. For example, if the speech competence of 50 students is measured across five indicators, the mean score and variance on a 100-point scale are calculated for each indicator. These figures provide an overview of the overall level of preparedness and reveal which indicator shows the greatest weakness among students [26]. A large standard deviation indicates high heterogeneity within the group, pointing to the need for an individualised approach.

At the inferential statistics stage, Student's t-test is used to compare the experimental and control groups. The resulting p-value (the acceptable margin of error) is compared with 0.05: if $p < 0.05$, the difference between the groups is considered statistically significant. In small-sample studies involving children with hearing impairments, or when the assumption of normal distribution is not met, non-parametric methods such as the Mann-Whitney U-test are used. To analyse the growth in speech competence (the difference between pre-test and post-test results), the Wilcoxon test or a paired-samples t-test is applied. Effect size (Cohen's d) is calculated to assess the practical significance of the intervention: $d \geq 0.5$ is considered a medium effect, and $d \geq 0.8$ a large effect.

To examine relationships among indicators of speech competence, Pearson correlation (for interval-level measures) or Spearman rank correlation (for ordinal scales) is calculated [27]. For example, a strong positive correlation ($r > 0.60$, $p < 0.05$) between the quality of theoretical linguistic knowledge and the speech-correctional planning indicator would suggest that these two indicators develop concurrently on the basis of theoretical knowledge. In multivariate studies, multiple linear regression analysis may be used to identify the factors influencing speech-competence scores (hours devoted to sign language, mentoring experience, professional development courses) and to determine their relative influence through regression coefficients [28].

Factor analysis is also used as an important

supplementary method: when a set of items measuring the five indicators of speech competence is developed, factor analysis clarifies the extent to which these indicators are independent of, or related to, one another. This helps questionnaire developers determine which items correspond to which components of speech competence and whether any items are redundant or unnecessary [29]. In contemporary research, statistical analysis is generally carried out using statistical software (SPSS, R, Stata). When interpreting results, the meaning underlying the figures must be clearly explained, ensuring that the analysis serves to answer the research questions posed.

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