

Validation of a Model for the Quality of Education in Multi-Grade Classrooms in Primary Schools

Esmat Badakhshan Toroghi¹, Mahboobeh Soleimanpour Omran^{2*}, Rokhsareh Fazlli³

1. PhD student, Department of Management, Qaimshahr Branch, Islamic Azad University, Qaimshahr, Iran.
2. Assistant Professor, Department of Educational Sciences, Bojnord Branch, Islamic Azad University, Bojnord, Iran.
3. PhD, Department of Educational Psychology, Deputy Director of Child Education Organization, Ministry of Education, Tehran, Iran.

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Purpose: Quality of education in multi-grade classrooms is important in the education system, neglect of which is associated with the weakness of the education model and related factors.

Methodology: The present study was conducted to validate a model for the quality of education in multi-grade classrooms in primary schools as exploratory research. In qualitative study, thematic analysis was used by an inductive approach, and in quantitative study, descriptive survey was used. Given the components, an 81-item questionnaire was provided. To validate the questionnaire, convergent validity, content validity and construct validity were used. The statistical population of the research included teachers, principals and educational leaders of multi-grade classrooms in all the cities of North Khorasan Province, including 1203 multi-grade classrooms. By Cochran's formula, 349 people were selected as the research sample. The structural model of the research was fitted and the path coefficients of the research model were analyzed by the bootstrap method (resampling and sequential sampling) and the Student's t-test statistic.

Findings: According to the results, 0.823% of the changes in the quality of multi-grade classrooms have been predicted by the sub-components of teachers' professional competence and characteristics, macro policies, the state of schools, family model and themes related to the students.

Conclusion: All questions were confirmed due to a factor load above 0.5, and the model had a good fit.

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* Corresponding Author Email: m.pouromran@gmail.com

1. Introduction

Over the last decade, economic, cultural, and political structures have been changed significantly. One of the concepts to describe these changes is globalization and the structure of an efficient educational system (Lewellen, 2010). Multi-grade school is a global phenomenon, and most countries' philosophy of existence is to achieve the international goal of "education for all" (EFA). Remote, sparsely populated and inaccessible areas need the development of more educational opportunities and seek access to quality education. The *United Nations Educational, Scientific and Cultural Organization* (UNESCO) documents show that multi-grade education is not only to resolve the shortage of teachers in educational systems, but also it is considered as a strategy to improve the quality of education in rural communities (Shahrabadi, 2021: 138). In this regard, multi-grade classrooms are one of the strategies of education to access quality education for all schools in less developed and remote areas (Sali, M & Arriola, 2019:18). Education in multi-grade classrooms is considered to provide access to and complete the primary course, continue educational services and increase access to education in rural, nomadic and sparsely populated areas, optimal use of limited resources and improve the quality of education (Pourmand, 2017: 2). Multi-grade classrooms, where students from two or more classrooms are grouped in one class, are common in many developing and developed countries. According to UNESCO, almost a third of all classrooms in the world are multi-grade. The underlying logic of forming a multi-grade classroom varies from the lack of students (in rural and mountainous areas) to the lack of teachers (in poor countries) (Checchi & De Paola, 2018).

Education is the main educational factor and the most important component affecting the structure of society and nurturing the future generation in the process of knowledge transfer (Lilian, 2016). Correct education and its implementation in the educational process is one of the most important goals of any educational system to provide the basis for the growth and development of the educational system (Cvijovic et al., 2016). Therefore, one of the most important indicators of using correct and appropriate educational principles for students and improving learning skills and related principles is related to the teacher and the related model (Karolecik et al., 2017). Accordingly, a special curriculum for multi-grade classrooms should be prepared that is compatible with the time conditions and limitations of these areas, which in addition to achieving the goals of the educational system, meets the special needs of the students of multi-grade classrooms (Hamidzadeh, 2021: 130).

In addition, the teacher is the most important element affecting the quality and performance of education and teachers play the most important role in improving the quality and efficiency of the curricula for students and education (Rezaei & Sulaimanpour Omran, 2015). In a study, Makena and Mpahla (2022) showed that the current teachers of multi-grade schools do not have the required educational knowledge and specialized knowledge that can improve the quality of education by the quality of teaching. Accordingly, the employment of capable and qualified people in this field is one of the important issues to be investigated in this field (Msimanga, 2019).

Among the reasons for the formation of multi-grade classrooms in Iran, the following can be mentioned: the lack of teachers and human resources, the dispersion of villages and the inadequacy of roads between villages and cities, and the lack of access to suitable vehicles to attend single-grade schools, ethnic and tribal prejudice that prevents students from attending schools in other areas, reducing the number of grades in a school, which leads to the removal of one or more grades or all grades, a reduction in the number of students in a rural area due to the use of children who need to be educated in agriculture, animal husbandry, carpet weaving, etc., and a reduction in the population of villages due to migration to cities (Educational Research and Planning Organization, 2021: 2).

The same content of multi-grade textbooks as that of single-grade classrooms, the same approved schedule as that of single-grade classrooms (25 hours per week), teaching more than one curriculum at the same time, the multiplicity of teacher roles and duties, the inadequacy of courses and references for teachers, time limitation and lack of teacher's time due to the same textbooks as single grade classrooms, problems caused by the wide age range of 6-15 years in classrooms with six grades, the elimination or fading of a number of

subjects such as art or sports, the aggravation of problems caused by the bilingualism of students in some areas of the country, the presence of boys and girls in most classrooms, especially in the second grade of primary school, the excessive absence of students in rural areas, and the negative attitude towards multi-grade education are the challenges in multi-grade classrooms. It is necessary to pay sufficient and necessary attention to solve them (Educational Research and Planning Organization, 2021: 12). It should be noted that if problems and challenges are not identified and found correctly; there will be consequences such as reduced academic performance, students' academic failure, teachers' lack of motivation, and psychological problems for teachers and students (Nabipour & Baratali, 2021:191). Resolving the challenges of multi-grade classrooms has a direct relationship with the quality of these classrooms. So that many factors play a role in the quality and it is necessary to analyze all dimensions in this field. In this field, various studies such as Ashfaq, Yousuf and Dahar (2018) emphasized the lack of a comprehensive quality system in different dimensions in this educational system. In a study, Hasani Abd, Hasani and Beig Mohammadi (2021) investigated the challenges in multi-grade classrooms and showed that multi-grade classrooms face limitations and challenges such as managing multi-grade classrooms, lack of time, lack of opportunity to practice and repeat, bilingualism, etc. Taole and Mncube (2012) evaluated the facilities and conditions in different and macro sectors as factors of sector quality in this field. The results of another study by Mutambala (2022) showed that programs and policies should be prepared and provided to teachers and school administrators in multi-grade teaching. Because teachers who run multi-grade classrooms teach using single-grade curriculum and methods. For this reason, it was suggested to include a multi-grade curriculum instead of a single-grade curriculum. Also, the study results of Abbasi (2021) showed the factors affecting the quality of multi-grade classrooms: 1) changing the curriculum of multi-grade classrooms, 2) using active teaching methods such as game-based teaching methods, 3) using the method of fellow students, 4) apprenticeship in teacher training courses, 5) in-service training, 6) multi-media training, and 7) compilation of educational materials for multi-grade classrooms.

Studies have shown that multi-grade classrooms have a special educational situation and a careful and scientific effort to help teachers develop the skills and knowledge necessary to provide quality education in these classrooms and changes in the curricula to coordinate the needs of students in multi-base situations seems necessary (Shahrabadi, 2021: 19). Accordingly, the quality of multi-grade classrooms requires attention to different dimensions. In this regard, the children of the rural and less developed areas of our beloved country of Iran, who will be the future builders and economic arms of the country, will not be equipped with enough knowledge. Given that there are 497 schools of different educational grades in Bojnord, 260 schools are located in rural areas and the rest are located in the city. In the development document of this province as a whole and Bojnord in particular, a clear emphasis is on educational justice and conditions for all students (North Khorasan Province Development Plan Document, 2017-2021). Therefore, given the existing educational shortcomings on the one hand and the development document's emphasis on the expansion of educational coverage, the expansion of educational justice, and the quality of the education process of students in multi-grade classrooms, this study was conducted to validate a model for quality of education in multi-grade classrooms in primary schools in North Khorasan Province.

2. Methodology

In this study, qualitative approach and thematic analysis were used to identify components affecting the quality of education of multi-grade classrooms. For the approach, this study is exploratory; Therefore, the approach of this study is a combination of qualitative and quantitative (mixed) approaches, in which appropriate qualitative methods, including exploratory interviews, have been used to extract research components and measures. Quantitative methods have been used to verify the measurement models and test the conceptual model. The 3 stages of research are as follows: literature review, qualitative study and quantitative study. In the literature review, the theoretical principles and studies related to the subject were analyzed by a systematic approach. In the qualitative study, the main objective was to investigate and identify the

components of quality improvement in the teaching and learning process and provide a suitable model for developing a questionnaire for the quantitative study. In the quantitative study, descriptive survey was used. The statistical population included teachers, principals and educational leaders of multi-grade classrooms in all the cities of North Khorasan Province, which were 1203 multi-grade classrooms. According to Cochran's formula, 349 people were selected as the statistical sample of the research. To investigate the factors affecting the quality of multi-grade education, the dimensions at the level of individual, family, school, community and situational conditions were proposed. For this purpose, a researcher-made questionnaire with 81 questions was used, the content validity of which was confirmed by 5 experts. The reliability and validity of the tool, given the researcher-made tool based on the qualitative content of the research, can be confirmed. In the first part, content validity was confirmed based on the approval of 5 experts, including supervisors and advisors. Then, construct validity was confirmed based on the factor analysis model of the measurement accuracy in the content, and the reliability and repeatability of the tool was confirmed based on Cronbach's alpha. Given that the average variance extracted (AVE) for all research concepts and dimensions is higher than 0.50, since convergent validity is confirmed when AVE is higher than 0.50, it can be said that convergent validity for all concepts and dimensions of the research is confirmed. Also, the reliability of each component, indicating the internal fit of the test items, is higher than 0.7 in all components, indicating the adequacy of the tool. The preliminary test of the questionnaire was conducted on 30 people from the statistical sample and the problems related to the clarity, comprehensibility and acceptability of the questionnaire questions were reviewed after the preliminary implementation and the next participants completed the modified version of the questionnaire. Questionnaires were sent in person or by e-mail (both according to the response conditions) to the desired samples. After confirmatory factor analysis (CFA), the desired model was presented. For quantitative study, CFA and structural equation modeling by AMOS 24 were used. Also, other sections of this study, including descriptive tests and normality, were reviewed by SPSS 24.

3. Findings

Based on the descriptive information of the research subjects, including participants in the quantitative part, 71% of the statistical sample of this study were men and 29% were women. Most of the participants in this study had a bachelor's degree with 62% participation in this study. 83% of the statistical sample of this study were teachers; 14% were educational leaders and 2% had administrative organizational positions. In the first part, the normality of the data distribution was investigated based on the Kolmogorov-Smirnov test, which according to the significance of 0.5 in all dimensions of the data distribution is normal and parametric test was performed. In the next part, the structural model was examined and the research model was fitted. For this purpose, the significance and path coefficients of the research model were investigated using the bootstrap method (resampling and sequential sampling) and the Student's t-test statistic (by SPSS). The coefficient of determination (R^2) is 1 and other values are between the two. R^2 close to 0.67 is considered desired, close to 0.33 is normal, and close to 0.19 is considered weak. Finally, the predictability of the model is also evaluated using Stone-Geisser statistic (Q^2): CV.Redundancy and CV.Community. CV.Redundancy evaluates the structural model and measurement model simultaneously and CV.Community only evaluates the measurement model. A positive and large Q^2 indicates high predictability of the model, and negative Q^2 indicate a very poor estimate of the latent variable. R^2 and Q^2 of path coefficients are shown in Table 1.

Table 1. R² of the research model

dimensions	R ²	CV.Red	CV.Com
Teachers' characteristics	-	0.582	0.663
Family model	-	0.744	0.815
State of schools	-	0.736	0.723
Macro policies	-	0.499	0.524
Themes related to students	0.82	0.582	0.711

As shown in the above table, R² of the latent variables of the model shows that dependent variables are affected by the independent variable. Also, the results show that 0.823% of changes in the quality of multi-grade classrooms are predicted by the sub-components (model dimensions). The study results of Q² show that none of the values of Q² are negative and the minimum values required for prediction have been met. Another assumption of structural equation analysis is to check the homogeneity of variances regarding research variables using Levene's test. Considering the significance level of the categories, which was more than 0.05 in all variables, it can be claimed that the categories and sub-categories of the research model have homogeneous variance and concluded that the homogeneity of variances has been observed. Then, the collinearity of the dimensions of the research model was examined. Another assumption for conducting structural equation analysis was checking the absence of multiple collinearity of variables. For this purpose, variance inflation factor (VIF) and tolerance were used. In this study, the dimensions of the model do not have a VIF higher than 5 and tolerance of less than 0.1, as a result, multiple collinearity between the model dimensions is not observed. Next, CFA of the research variables was performed. Table 2 shows the results of CFA of the observed variables for the latent variables.

Table 2. Results of CFA of observed variables and latent variables

observed variables (questions)	Factor load	confidence interval (significance level or P-value)	limit	result
1	0.688	0.000	above 0.5	confirmed
2	0.611	0.000	above 0.5	confirmed
3	0.684	0.000	above 0.5	confirmed
4	0.589	0.000	above 0.5	confirmed
5	0.512	0.000	above 0.5	confirmed
6	0.703	0.000	above 0.5	confirmed
7	0.529	0.000	above 0.5	confirmed
8	0.875	0.000	above 0.5	confirmed
9	0.741	0.000	above 0.5	confirmed
10	0.705	0.000	above 0.5	confirmed
11	0.632	0.000	above 0.5	confirmed
12	0.863	0.000	above 0.5	confirmed
13	0.815	0.000	above 0.5	confirmed
14	0.663	0.000	above 0.5	confirmed
15	0.664	0.000	above 0.5	confirmed
16	0.548	0.000	above 0.5	confirmed
17	0.522	0.000	above 0.5	confirmed
18	0.548	0.000	above 0.5	confirmed
19	0.782	0.000	above 0.5	confirmed

20	0.756	0.000	above 0.5	confirmed
21	0.723	0.000	above 0.5	confirmed
22	0.641	0.000	above 0.5	confirmed
23	0.613	0.000	above 0.5	confirmed
24	0.682	0.000	above 0.5	confirmed
25	0.775	0.000	above 0.5	confirmed
26	0.502	0.000	above 0.5	confirmed
27	0.846	0.000	above 0.5	confirmed
28	0.582	0.000	above 0.5	confirmed
29	0.857	0.000	above 0.5	confirmed
30	0.593	0.000	above 0.5	confirmed
31	0.802	0.000	above 0.5	confirmed
32	0.544	0.000	above 0.5	confirmed
33	0.777	0.000	above 0.5	confirmed
34	0.790	0.000	above 0.5	confirmed
35	0.662	0.000	above 0.5	confirmed
36	0.772	0.000	above 0.5	confirmed
37	0.828	0.000	above 0.5	confirmed
38	0.699	0.000	above 0.5	confirmed
39	0.777	0.000	above 0.5	confirmed
40	0.818	0.000	above 0.5	confirmed
41	0.664	0.000	above 0.5	confirmed
42	0.723	0.000	above 0.5	confirmed
43	0.525	0.000	above 0.5	confirmed
44	0.569	0.000	above 0.5	confirmed
45	0.598	0.000	above 0.5	confirmed
46	0.712	0.000	above 0.5	confirmed
47	0.801	0.000	above 0.5	confirmed
48	0.582	0.000	above 0.5	confirmed
49	0.669	0.000	above 0.5	confirmed
50	0.541	0.000	above 0.5	confirmed
51	0.523	0.000	above 0.5	confirmed
52	0.664	0.000	above 0.5	confirmed
53	0.717	0.000	above 0.5	confirmed
54	0.663	0.000	above 0.5	confirmed
55	0.701	0.000	above 0.5	confirmed
56	0.664	0.000	above 0.5	confirmed
57	0.582	0.000	above 0.5	confirmed
58	0.556	0.000	above 0.5	confirmed
59	0.734	0.000	above 0.5	confirmed
60	0.589	0.000	above 0.5	confirmed
61	0.698	0.000	above 0.5	confirmed
62	0.547	0.000	above 0.5	confirmed
63	0.801	0.000	above 0.5	confirmed
64	0.602	0.000	above 0.5	confirmed

65	0.744	0.000	above 0.5	confirmed
66	0.598	0.000	above 0.5	confirmed
67	0.724	0.000	above 0.5	confirmed
68	0.667	0.000	above 0.5	confirmed
69	0.821	0.000	above 0.5	confirmed
70	0.561	0.000	above 0.5	confirmed
71	0.529	0.000	above 0.5	confirmed
72	0.714	0.000	above 0.5	confirmed
73	0.618	0.000	above 0.5	confirmed
74	0.593	0.000	above 0.5	confirmed
75	0.713	0.000	above 0.5	confirmed
76	0.522	0.000	above 0.5	confirmed
77	0.593	0.000	above 0.5	confirmed
78	0.782	0.000	above 0.5	confirmed
79	0.602	0.000	above 0.5	confirmed
80	0.544	0.000	above 0.5	confirmed
81	0.581	0.000	above 0.5	confirmed

As shown in Table 2, the factor load, indicating the role of the observed variables in explaining the underlying variable, has been confirmed in all questions due to having a factor load above 0.5. Therefore, all the variables of the research, most of the observed variables or the questions of the questionnaire were confirmed in terms of construct validity.

Discriminant validity was also confirmed for the dimensions of the research model. One of the methods of confirming this validity is Fornell and Locker criterion. Table 3 shows that the constructs are completely separated; i.e., the values of the main diameter for each latent variable are higher than the correlation of that dimension with other reflective latent dimensions in the model.

Table 3. Fornell and Locker criterion for discriminant validity

Latent variables	1	2	3	4	5
Teachers' characteristics	1				
Family model	0.556	1			
State of schools	0.699	0.523	1		
Macro policies	0.682	0.584	0.783	1	
Themes related to students	0.582	0.643	0.698	0.663	1

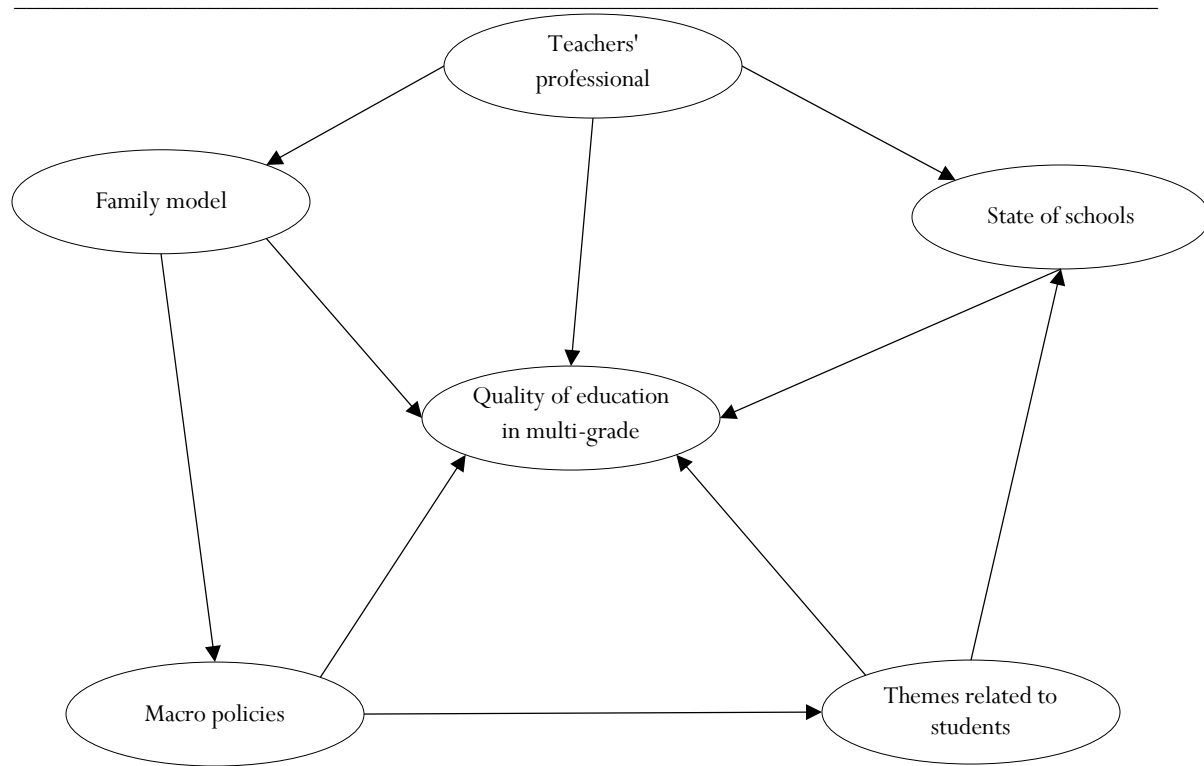


Figure 1. Model significant quantification

The structural equation modeling shows that the factor load of all the observed variables is higher than 0.3, so these factors measure the latent variables well. For the model fit, goodness of fit indices including: goodness of fit index (GFI), adjusted goodness of fit index (AGFI) and root mean square error of approximation (RMSEA) have been used. The values in Table 5 show that the results of the model are reliable. Because GFI and AGFI are both estimated more than the limit, and this statistic was higher than the criterion of 0.9. Also, the ratio of chi-square to the degree of freedom (X^2/df) has shown a suitable value. Also, RMSEA was estimated to be 0.03, which was less than the allowable limit of 0.08. Based on the estimates presented, it can be concluded that the model tested in the population had a relatively good and acceptable fit. Therefore, the results of the research model show that the model used in the present study had a good fit.

Table 4. Statistics related to the goodness of fit of the model

Fit indices	symbol	criterion	value	result
ratio of chi-square to the degree of freedom	X^2/df	$3 \geq$	1.47	Good fit
root mean square error of approximation	RMSEA	$0.08/0 \geq$	0.03	Good fit
goodness of fit index	GFI	$0.9/0 \leq$	0.95	Good fit
adjusted goodness of fit index	AGFI	$0.9/0 \leq$	0.91	Good fit
comparative fit index	CFI	$0.9/0 \leq$	0.94	Good fit
incremental fit index	IFI	$0.9/0 \leq$	0.92	Good fit
normed fit index	NFI	$0.9/0 \leq$	0.92	Good fit
non-normed fit index	NNFI	$0.9/0 \leq$	0.90	Good fit

At the end of the ranking of the factors according to the results of Friedman test, teachers' professional competence, the state of schools, macro policies, topics related to students and the family model were more

effective on the quality of multi-grade classrooms. Also, according to the results of the Friedman test, at significance level of less than 0.01, the ranking of the 5 factors is significant at 99% confidence interval.

4. Conclusion

For quantitative study and fit of the model, the significance level and path coefficients of the research model were reviewed using the bootstrap method (re-sampling and sequential sampling) and Student's t-test (using SPSS). In fact, R^2 to correlation coefficient is considered as a more expressive criterion and is the most important criterion that can be used to explain the relationship between two variables. R^2 for the variables of the model indicates the dependent variables affected by the independent variable. The results showed that 0.823% of changes in the quality of the multi-grade classrooms are predicted by the sub-components (model dimensions). The study results of Q^2 showed that none of the Q^2 values were negative and the minimum values required for prediction were met. In the following, the value of the factor load, indicating the role of the observed variables in explaining the latent variable, has been confirmed in all questions due to having a factor load above 0.5. Therefore, all the latent variables of the research, most of the observed variables, or the same questionnaire questions were confirmed in terms of construct validity and based on the optimal fit of the final model, the designed model was confirmed. This finding is consistent with the results of the following studies. Khademi et al. (2021) investigated multi-grade classrooms, opportunities and challenges. They stated that on the one hand, the management of multi-grade classrooms, including planning, organization, leadership, guidance, control and evaluation, if realized, will include the possibility of improving the quality, academic achievement and discipline of students, and with better class management, an increase in learning of students and the growth of students' self-confidence is achieved, and on the other hand, by teaching class management and time and classroom methods to inexperienced teachers of multi-grade classrooms, the problems and limitations of these classrooms can be resolved. In another study, Merson (2022) investigated experiences of teachers of multi-grade classrooms in Lak district and showed that multi-grade teaching should be revised to meet the needs of multi-grade teachers. The physical condition and atmosphere of multi-grade schools should be evaluated. Educational supplies, technology, and educational materials should be better equipped. Also, multi-grade teacher compensation or allowances, class size formatting, teacher training needs assessment, relocation of school sites to safer areas, provision of infrastructure, presentation of short-term courses or continuing professional development of multi-grade teachers, and conducting research should be considered more to improve the quality of education in multi-grade schools. The results show that the quality of multi-grade classrooms requires a wide perspective by a broad approach in all the themes raised. In other words, a teacher who is in charge of teaching by this model should have extensive specialized and executive ability in educational topics, based on participation in education, the use of students in the teaching process, lesson planning, and the correct use of time and place and specialized knowledge of new educational tools in this field. Also, it is necessary for the families of these children to play a role in establishing and practicing education in this field with close communication with the teacher and the education staff. In addition, the balanced and supportive government programs and policies, as well as the condition and utility of the school, along with paying attention to the special conditions of the students, are the basis of the improvement in the quality of this educational path. In general, the quality and improvement of conditions in this field requires serious determination based on efficient and correct communication in all dimensions involved in this field, which can be realized by support and detailed and comprehensive planning in this field. This study can be conducted in other populations and areas for comparability and adaptation in this field. Also, each of the identified categories in the process of affecting the quality of multi-grade classrooms can be comprehensively analyzed as a separate category for a deeper understanding. According to the study results, some practical suggestions are also presented for the educational authorities and the authorities of society as follows:

1. Specialized training courses for teachers of multi-grade classrooms should be conducted based on macro-educational policies.

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2. The time of these classrooms should be out of the educational rule, and with the possibility of a wider range, the teacher has more powers and the possibility of greater changes in this system in terms of starting and ending hours and attendance.
 3. In-service curricula for employees based on education of multi-level classrooms and identified components related should be designed and implemented twice a year.
 4. All multi-grade schools should have the minimum quality and the necessary tools in this field and the necessary materials should be provided in this field.
 5. Given the role of parents in providing quality to multi-level classrooms, the executive interactions between the teacher and parents should be carried out more and in educational classrooms to stabilize and improve the learning of students.
 6. The curricula in these classrooms should be accompanied by a more serious and mandatory model in the path of active education and engagement of students in education.
 7. Given students' characteristics as one of the factors of quality of multi-grade classrooms, effective communication strategies should be used to improve the teaching and learning process of students in multi-grade classrooms.

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