



Factors Affecting Students' Guesswork in Multiple Choice Questions and Corrective Strategies

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Abstract

One of the main concerns of those in charge of education and evaluation in universities is the issue of students guessing the answer in multiple-choice questions. This is concerning because a student who guesses the correct answer may lack the required knowledge. The results of various studies show that students use guessing to different extents. Factors of personality, gender, cultural differences, and cognitive level of questions, situation, test conditions, and test-takers affect students' guessing. Using multiple-choice questions, reducing the structural errors of the question, increasing the number of options, adding the 'I do not know' option, using a negative score, using the confidence assessment model, eliminating the option, and the liberal method have been suggested as solutions to deal with guessing answers in multiple-choice questions.

Key Words: Effective Factors, Guessing, Multiple Choice Questions, Student, Solutions.

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1- INTRODUCTION

Multiple choice (MC), objective response, or MCQ (for Multiple Choice Question) is a form of an objective assessment where respondents are asked to choose only the correct answers from the choices offered as a list. The multiple-choice format is most frequently used in educational testing, in market research, and in elections, when a person chooses between multiple candidates, parties, or policies (1). Multiple-choice items can be used to measure knowledge outcomes and various types of learning outcomes. They are most widely used for measuring knowledge, comprehension, and application outcomes. One of the major drawbacks of multiple-choice tests is the possibility of finding the correct answer through guessing. A student who cannot answer a particular question can simply select a random answer and still have a chance of obtaining a point. If the answer to a four-option question is chosen through random guessing, there is usually a 25 percent chance of getting the correct answer. It is common practice for students in the final minutes of a test to give all remaining questions random answers in the hope that they will get at least some of them right (2).

Students use two patterns for guessing the right choice in multiple-choice questions. In the first pattern, the student has no opinion on any of the options and, therefore, chooses one of the options randomly in the hope that it is the correct answer. In this pattern, called Blind Guessing, all options have an equal chance of being selected. The second pattern is when the student's guess is not completely random, but they remove or select options based on his "partial knowledge". In this pattern, called Informed Guessing, the student knows the correct answer to some extent; in other words, using logical reasoning or relying on their relative knowledge of the subject, they attempt to

guess the correct answer by omitting other options and choosing the correct option with some degree of certainty (3-7). With random guessing, an examinee's odds of correctly answering any given item increase with fewer response options (8). Given the advantages of guessing, one of the main concerns of professors is the students guessing the answer in multiple-choice questions. Various researchers have studied the issue and made recommendations on guessing. However, the results of the studies are so sparse and contradictory that they cannot clarify what students and professors can do about the issue. For example, Harden et al. (1976) believe that the evaluation of medical students should not be encouraging students to make guesses (6). Prihoda et al. (2006) show that in multiple-choice questions, guessing could increase the student's grades and they do not have a positive opinion about it (9).

On the other hand, it has been suggested that since learners are different in risk-taking, the best method to eliminate these differences is to answer any question, even with doubt, so that the examination does not turn into a personality test and its subjectivity is maintained (10). Concerns about guessing that lead the assessors to use strategies against it are mainly due to the effect of guessing on increasing students' grades as well as the psychometric properties of the test. The present study aimed to review the factors affecting students' guessing in multiple-choice questions and strategies to deal with this issue.

2- MATERIALS AND METHODS

2-1. Data sources

In this review study, a systemic search of electronic databases of Medline (via PubMed), SCOPUS, Web of Science, ProQuest, Cochrane Library, SID, Magiran, CIVILICA, and Google Scholar search engine was performed with no time

limit up to September 2021, using the following keywords alone or in combination: "Guessing", "Guesswork", "Effective Factors", "Multiple-Choice Questions", "Solutions", "Students", and "Corrective Strategies". The search was performed independently and in duplication by two reviewers and any disagreement between the reviews was resolved by the supervisor.

2-2. Study selection

Database search was done for suitable studies. Abstracts of the studies were screened for identification of eligible studies, full-text articles were obtained and assessed, and a final list of eligible studies was made. This process was done independently and in duplication by two reviewers and any disagreement was resolved by a third reviewer. References were organized and managed using EndNote software (version X8).

3- RESULTS

Experts believe that students use guessing to different extents.

3-1. Factors affecting guessing:

3-1-1. Personality traits: Personality traits, especially the risk-taking of individuals, affect the rate of guessing. Strategies such as negative marking are more indicative of differences in the rate of the risk-taking of students than their differences (3, 11, 12). Some researchers (e.g., Frary, 1988) recommend not penalizing for wrong answers. They claim that psychological factors or personal characteristics may influence the decision of students to omit questions that they have partial knowledge about and expect a reward from answering. In their study, Mar'ia Paz Espinosa et al. indicate that penalizing for wrong answers affects the number of items omitted and more risk-averse students omit more items. Risk-averse students omit items with a positive

expected score, so their expected score should be lower than that of risk-neutral students who answer those items with positive expected gain. However, the difference in scores obtained by risk-averse and risk-neutral students was not considerable (13).

3-1-2. Gender: Females are supposed to be more cautious than males in guessing the choices, and therefore, using negative marking increases their grades (14). In the studies of Bond et al. and Akyol et al., no difference was observed between the two genders (15, 16). Ben-Shakhar et al. found only a small difference between the grades of the two genders. That is, although gender affects students' willingness to guess, these differences had little effect on grades (17). In the study of Khatibi et al. who used the confidence evaluation model, the mean scores of female students were higher (18). Baldiga (2014) found that when no penalty is assessed for a wrong answer, all test takers answer every question. But when there is a penalty for wrong answers, women answer significantly fewer questions than men (19).

3-1-3. Cultural differences: According to Goldik, non-English speaking students used guessing less than English speaking students (20).

3-1-4. Cognitive level of the question: The cognitive level of the question may affect the rate of guesswork. The results of a study by Andra et al. showed that when the cognitive level of the question is high (i.e., it is more difficult), students use a lower level of guesswork (21). Tamir believes that when the cognitive level of the question is low, the student should be asked to refrain from guessing. But in questions of high cognitive levels, learners can be encouraged to use informed guessing (22). The study of Frary et al. showed that guessing increases measurement error and decreases test reliability (23).

Lord argues that formulaic scoring will always improve reliability (24). Cureton states that formulaic scoring increases test validity (25). Diamond and Evans report that there are many studies with increased narrative levels that use formulaic scoring (26). Campbell points out that formulaic scoring increases test reliability. He also showed that formulaic scoring improves validity (27).

3-1-5. Student attitude: One of the important factors that affect the rate of guessing considering the level of penalties is the learners' attitude toward guessing and its risk. Some individuals are very cautious so that even in case of a mild probability of penalty, they will only answer questions that they are sure of. On the other hand, there are individuals who answer all the questions regardless of the instructions for a penalty (28). This issue has been discussed in "decision theory under uncertainty". According to this theory, individuals are divided into three categories in terms of their attitudes toward guessing and the risk of penalty. Individuals who do not answer a question with a positive expected reward are called risk-averse. Individuals who answer all the questions with a positive expected reward are called risk-neutral, and individuals who answer questions with a negative expected reward are called risk-seeker. High levels of penalty prevent individuals with lower self-confidence and high anxiety from answering the questions they can answer (29).

3-1-6. Conditions of test and test-takers: The conditions of the test and test-takers also affect guessing. For example, the use of negative marking or the number of test questions affects learners' guessing behavior. This is why it is suggested that students should be informed in advance about the existence of negative marking and given clear instructions on guessing (3).

3-2. Strategies for dealing with guesswork in MCQs

Various strategies have long been used to reduce the guesswork in MCQs.

3-2-1. Using spectral answers

One of the methods is to use spectral answers. This means that a question has more than one correct answer, and to reduce the guessing rate, the item's score is divided between the correct options, and a negative point is assigned to the incorrect option.

3-2-2. Reducing structural errors of the question

Some experts believe that the best way to minimize the effect of guessing is using properly designed questions, as design errors give the student a clue to find the right option or help them eliminate one or two options.

3-2-3. Additional choices

Since it is easier to find the correct answer in three-choice tests than four-choice ones, additional options can be a solution. It must be borne in mind, however, that it is not easy to design optimal distracting options for each question.

3-2-4. Using negative marking

Another method to deal with guesswork is to include a negative marking for incorrect answers. In the usual method of marking (Positive marking), the student receives a specific point for each correct answer and zero for wrong answers or unanswered questions. Therefore, if the student does not know the answer to a question, they can still choose one answer randomly. If the answer is correct, they obtain a score, and if not, there are no consequences. So, students prefer to guess the answer even if they are unsure of the correct option. In another method (Negative marking), if the student answers the question correctly, they gain a point, but if not, they receive a negative point. In this way, wrong choices

are penalized and the student cannot easily use guesswork. In Iran, there is a negative marking in the national university entrance exam as well as the entrance exam for specialized assistants.

3-2-5. Use of "I don't know" option

Another method is to include the "I don't know" option along with other choices so that the student can use it if they cannot identify the correct answer. In this case, the student's overall score is the total number of correct answers minus the number of incorrect ones. That is, the student is given a score for each correct answer and their score is decreased for each incorrect one. This method is a subset of the negative marking method where the penalty is larger. One problem in using this method is that usually, even learned students are reluctant to make a choice. The students are therefore likely to use the "I don't know" option, which can decrease their scores.

3-2-6. Confidence assessment model

In another approach, known as the confidence assessment model, negative marking is again used, but in addition to the knowledge of the person, their confidence in answering the items is also considered. In this model, the student is asked to rate their confidence in their chosen answer for each question. Then, a negative point is considered for the wrong choices and a positive point for the correct choices that the student has been sure of. The advantage of this method over the negative marking is that, first, the student must be able to evaluate their knowledge and recognize their shortcomings, and second, it determines the student's level of successful guessing. That is, it is determined whether the learner is good at guessing or not. After the test, the student can compare their answer sheet with the key and not only focus on what they were unsure about but also can strengthen their

informed guessing skill by reviewing their answers.

3-2-7. Elimination testing

In the Elimination Testing method, the student is asked to eliminate as many wrong options as they find instead of recognizing the correct answer. When the student is not sure of the correct answer, they eliminate some choices with their relative knowledge. In one of the different models considered for this method, when the student does not eliminate any option, they receive a zero score (no knowledge). The student receives one unit score for each wrong option (partial knowledge). If they have removed all the wrong options, they will receive the whole score (perfect knowledge).

3-2-8. Liberal method

In this method, the learner is allowed to choose more than one option if unsure of the correct answer. For choosing the correct option in a four-choice question, the student receives one point, and for choosing each deviant option, one-third of the score is deducted. This method has also been suggested to prevent random guessing and to distinguish between students with complete and partial knowledge (3).

4- DISCUSSION

The present study reviewed the factors affecting student guesswork in multiple-choice questions and searched the strategies to deal with this issue. A review of the literature showed that student personality traits, gender, cultural differences, the cognitive level of the question, conditions of the test, and test-takers are effective factors for guessing. Using additional options, reducing structural errors of the question, increasing the number of choices, using the "I do not know" option, negative marking, confidence assessment model, elimination testing, and the liberal method have been

proposed as solutions to deal with the guesswork among students. One of the most widely used tools for assessing learners' levels of knowledge and learning is multiple-choice tests. The reason that multiple-choice tests are usually preferred over other forms of tests is their easy implementation, practicality in different contexts, the inclusion of large content, and their objective scoring so that the scoring measurement error is minimized (30). A major drawback of multiple-choice tests is the possibility of finding the correct answer through guessing (30).

Various methods have been proposed to reduce measurement errors from guesswork; for example, tests with a large number of questions or increasing the number of incorrect options for each question. In practice, the first approach (test with a large number of items) is not possible due to time constraints. Since it is not possible to design a large number of incorrect options for all questions, the second approach is also difficult in practice. The most common method to reduce the measurement error from guessing is the negative marking (penalize) for incorrect choices using formula scoring (31).

In the history of educational evaluation, the old debate remains whether the optimal test scoring procedure should incorporate penalties to prevent guesswork and incorrect answers. Despite the widespread use of multiple-choice tests, there is no consensus on whether incorrect answers should be penalized or what the level of penalty should be. There is also a long debate on whether the students should choose an answer for all questions in multiple-choice and true-false tests, and if necessary, use blind guessing, or they should be discouraged from guessing by using a penalty for incorrect answers (3, 32). Random guessing is believed to reduce test reliability (32). A review of data from three experimental studies

concluded that usual marking has a larger effect on reliability than the negative marking formula where students are more cautious (33). Increased test reliability was also reported when using the "I don't know" option and the elimination test (3). In the event of validity, since the degree of guessing is affected by the risk-seeking of the individuals, the use of negative marking affects the students' scores not only by their knowledge but also by their personality. Therefore, theoretically, it can be said that the test validity may be distorted by using a new structure and creating a variance unrelated to the structure (34).

One criticism of the guesswork is its effect on increasing the student's score. From a theoretical point of view, the student will answer the questions by guessing in multiple-choice questions and will gain better grades. Therefore, there is a general belief that by using strategies such as negative marking, the grade will decrease or at least not increase falsely, and the student will receive their real grade. The results of experimental studies are conflicting. In some studies, the use of the negative marking formula has had no effect on student behavior (31, 35).

In several others, when there was a negative marking, students' scores were lower and more questions remained unanswered (36, 37). In an experimental study on two groups of students, it was found that despite using negative marking, guesswork could increase students' scores (31). As for the "I don't know" option, some believe that its applications may lead students to become more cautious like the negative marking, and even with partial knowledge, they do not try to choose the right option (20). It was found in a study that when using the "I don't know" option, students' scores increased significantly (6), but in another study, despite the use of this option, students' scores showed a significant decrease (38). Muijtjens et al.

compared the elimination testing with the negative marking and concluded that students benefit from the elimination testing (39). Another study compared the liberal method with the normal scoring method and showed that if the student can correctly identify at least two deviant options, they will get a higher score in the liberal state than the normal scoring (40).

Another issue is the effect of prior information on student grades. The results of a study by Frary et al. on six scoring methods showed that providing incorrect information and instructions about guesswork during the test as well as relevant strategies leads to lower scores compared to cases where the instructions are not provided (23). In the study of Betts et al., the students who were told negative marking will not be applied performed significantly better than students who were told otherwise (37). On the other hand, the better students are the ones that benefit the most from the guesswork in a test with negative marking, and the weaker students would be disadvantaged by guessing (31).

It should be noted that negative marking prolongs the test time because learners are slower in such a test (31). This issue is manifested mostly in timed tests and has a greater impact on students' performance (3). Brown et al. believe guessing is not necessarily a problem. A test is designed to distinguish between candidates, not to provide an absolute score. Scores usually end up being scaled to make the distribution equivalent to other forms of assessment. Scaling can be adjusted to the overall inflation of scores due to correct guesses. Therefore, guessing is only a problem when it inflates the measurement error and thus reduces reliability (41).

5- CONCLUSION

Methods of normal scoring (without negative marking) and negative marking have their advantages and disadvantages. However, a few points should be noted

when using each of these two methods. When using negative marking, the purpose of the evaluation should be considered. If the test is formative and is supposed to help the student learn and find their weak areas and improve their performance, negative marking is not needed. Also, if the purpose of the test is to rank students, it is not necessary to use negative marking, since it does not change the ranking of individuals. But if the knowledge of students is to be decided and those with poorer performance are to be removed from the system, the negative marking strategy is to be used.

Negative marking also reduces the likelihood of informed guessing and prevents the student from answering based on their partial knowledge. Negative marking can be helpful in graduation and driving license exams because at the beginning, in addition to being confident of their knowledge, the individuals must also know the limitations of their knowledge and be able to realize when it is necessary to consult books and resources. On the other hand, it should be noted that the students should be informed in advance whether the exam has negative marking or not, and this issue should be mentioned within the exam instructions. This is because, in the multiple-choice tests, the student performance is influenced by their prior knowledge as well as the guidance given to them.

6- AUTHORS' CONTRIBUTIONS

Study conception or design: ASG, SMH, and AM; Data analyzing and draft manuscript preparation: GS, FV, RK, and NM; Critical revision of the paper: MSG, and SMH; Supervision of the research: AM and MSG; Final approval of the version to be published: MSG, SMH, GS, FV, RK, NM, and AM.

7- CONFLICT OF INTEREST: None.

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