

# Data Analysis of two-tier items via a probabilistic modeling approach

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## Abstract

The two-tier item format as a way to assess students' science concept learning has gained popularity in recent years (e.g. Treagust, 1988). A typical two-tier item contains two portions, both framed in a multiple-choice format. The purpose of the first portion is to assess whether students can provide factual knowledge regarding a certain phenomenon stated in the item stem, while the second portion assess if they can demonstrate knowledge regarding the reason behind the given phenomenon. Certainly, the applicability of this format is not limited to the field of science education alone. So far as the data analysis is concerned, the usual way is to report the percentages of various combinations of options chosen by students across the two portions. The present paper, however, has modified an idea from Knapp(1977) by suggesting a probabilistic modeling approach that attempts to estimate several useful parameters concerning the performance of students on a two-tier item. A total of two models will be discussed. The first model will estimate such parameters as the proportions of students who know the answers to both portions, the proportions of those who know but are distracted in answering the first portion, as well as the proportion of knowers who are distracted in answering the second portion. The other model will, however, estimate the proportion of those who know the answers to both portions, the proportion of those who know the answer only to the first portion, together with the proportion of knowers who get distracted in answering the two-tier item. The motivation behind these two models together with the analytical and EM estimation procedures will be presented in the full paper. Several examples will be provided followed by a discussion of the conditions under which the two models are applicable. Part of the first model has been presented at the annual meeting of American Educational Research Association (Tam and Young, 2002). The present paper modifies and extends that model while proposing a new one.

## References

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