



Evaluation Report: Summary

Student and Teacher Feedback from Pilot Testing with Quantum Artificial Intelligence (AI) Tutors

Independent research was conducted by Wexford, Inc., a non-profit educational agency focusing on research, evaluation, equity and strategic development to improve education.

Research Objectives

Field test the Quantum Tutor for Balancing Chemical Equations and collect teacher and student feedback on the functionality and performance of the artificial intelligence technology embedded in the software.

Methodology

- Six teachers participated in the pilot program (one from Kentucky, one from Pennsylvania and four from California).
- Each teacher used the Tutor program with one class section.
- 304 demographic surveys were completed by teachers and students prior to the study.
- At the conclusion of the pilot, students were asked to complete a second survey to provide feedback on their use of the AI software.

Key Findings

In examining the table below (Figure 1), students responded well to the Quantum software just as they do with a human tutor. Item (a) shows that students prefer a human teacher/tutor for introducing and explaining material. For reviewing material, asking questions and working through problems, the Quantum Tutors are viewed as comparable with human tutors (Items b, c and d), especially when compared to "Other Tutorial Software." For Items (e) and (f), students dramatically preferred Quantum over a human tutor for activities such as doing homework, reviewing concepts and practicing problems. In summary, Quantum significantly outperforms other tutorial software and satisfies student need for on-demand assistance when a human teacher/tutor is not available.

"Students report that they found the AI programs far better than 'traditional' tutorial software; they like the option of 'just in time' help, and over 90% of the respondents indicated they would use Quantum again and recommend it to their friends who needed help in chemistry."

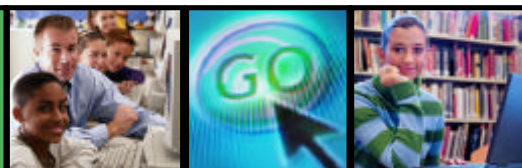
— Selma Sax
Senior Evaluator
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Figure 1: Student Comparison of Quantum Tutor to Other Tutorial Software

Survey Question: "Now that you have used the Quantum Tutor, please compare it with having a face-to-face tutor or other tutorial software you may have used."

Item	Responses	Quantum Tutor		Face-to-Face Tutor		Other Tutorial Software	
		#	%	#	%	#	%
a. Understanding the material is easier with	117	34	29.1%	81	69.2%	2	1.5%
b. Reviewing the material is easier with	116	55	47.4%	59	50.9%	2	1.5%
c. Questions are answered to my satisfaction with	114	50	43.9%	60	52.6%	4	3.5%
d. Time spent is more effective with	112	56	50.0%	53	47.3%	3	2.7%
e. I can use my own problems to clarify my understanding of the material with	114	77	67.5%	35	30.7%	2	1.8%
f. I can work at my own pace with	116	93	80.2%	20	17.2%	3	2.6%

Inspiring students to learn why



Demographic Survey Results

- 66.8% indicated that they spent less than 1 hour on chemistry homework daily.
- 97.0% spent anywhere from 1 to 3 hours preparing for a chemistry exam.
- 90.0% of the respondents indicated they had Internet access and 62.2% had broadband access.

Feedback from Students Using the Quantum Tutors

- 89.1% responded that they would use this kind of tutorial software program for other sections of chemistry, as well as other subjects.
- 92.2% indicated that they would recommend the Quantum Tutor to their peers.
- Only 2.3% (3 students) indicated they were not satisfied with the Quantum Tutor (Figure 2).
- 77.6% indicated they used the Tutors exclusively at home.
- The highest ranking Tutor feature found most useful was allowing students to enter their own problem (Figure 3).
- 66.4% indicated they liked the option of using the Tutor any time at their convenience, and 57.6% indicated they used the Tutor late in the evening.

Figure 2: Student Overall Satisfaction with Quantum Tutor

Responses = 128	#	%
Not satisfied	3	2.3%
Somewhat satisfied	31	24.2%
Satisfied	83	64.8%
Very Satisfied	11	8.6%

When respondents were asked what they liked best about the Quantum Tutors:

- 53.0% indicated they liked being able to enter their own problem (Figure 3).
- 43.9% indicated that they liked receiving positive feedback and guidance on how to correct mistakes (Figure 3).

When learning a new topic, the Quantum Tutors help struggling students understand where to start and what questions to ask.

When respondents were asked what they liked least, the answer given most often was that students could not enter their own questions. However, giving students a list of evolving questions that change based on how they are approaching the problem was intentional in the design of the Tutor, and is proven more effective in modeling good learning behaviors. When learning a new topic, many struggling students don't know where to start or what questions are important to ask. By teaching students to ask better questions, a broader understanding of the subject matter is achieved.

Conclusions

Based on this study, students view the Quantum Tutor as useful and effective for studying chemistry and an important **supplement** to classroom learning, textbook reading and labs. Equally important, the Tutors provide convenient, personal tutoring help to students when a teacher isn't available to help or answer questions.

Figure 3: Quantum Tutor Features

Survey Question: "Which feature(s) of the Quantum Tutor did you find most useful to you personally?"

Responses = 132	#	%
Being able to put in my own problem	70	53.0%
Being able to ask questions about my problem	59	44.7%
Receiving comments on my own work	58	43.9%
Having the opportunity to have the Tutor take steps for me and explain them	56	42.4%
Being able to continue to question the responses until I understood the answer	52	39.4%
Having the transcript of the entire problem at the bottom of the screen	36	27.3%
Having a set of questions to help me determine where to begin	31	23.5%