

Evaluation Report for STEP II Project – Center
for Occupational Research and Development
(CORD)

Student Questionnaire Results
2004

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Table of Contents

Background	3
Executive Summary	6
Detailed Results	10
Parts of Module Taught	11
Perceived Adequacy of the Amount of Material in Modules	11
Perceived Difficulty of Each Module Component	13
Perceived Quality of Each Module Component	19
Organization of Each Module Component	21
Recommended Use of Course Modules	22
Use and Satisfaction with Supplemental Guide	24
Open-Ended Comments	27
Student Questionnaire	38

Background

An Overview of Evaluation Methodology and Analyses Used in this Report

Background

In 1997 the Center for Occupational Research and Development (CORD) initiated the development of a series of photonics curriculum modules. The materials were designed to address a critical shortage in trained photonics technicians and in photonics instructional materials. This work was funded through the National Science Foundation's Advanced Technological Education program under a project titled STEP I (STEP – Science and Technological Education in Photonics). CORD continued its initial work through STEP II, a follow-up project designed to further develop and improve the photonics modular learning materials. The two primary outcome objectives of the STEP II project are as follows: 1) Update and improve modular learning materials for the existing course, Fundamentals of Photonics and 2) Develop new modules that support the mathematics level and content required by the photonics core curriculum. The evaluation of these STEP II objectives involved three components: pre and post content assessment, instructor satisfaction with modules, and student satisfaction with modules. The present report focuses on student satisfaction and involved the distribution of questionnaires to all students in participating courses. The questionnaires were distributed to seven professors representing six different states. The evaluator met with the professors in January 2004 to discuss the details of questionnaire distribution. The following six modules were incorporated into participating classes:

- Module 1-1 Nature and Properties of Light
- Module 1-2 Optical Handling and Positioning
- Module 1-3 Light Sources and Laser Safety
- Module 1-4 Basic Geometrical Optics
- Module 1-5 Basic Physical Optics
- Module 1-6 Principles of Lasers.

Each professor incorporated one or more modules into their courses. Students were given pre and post tests to determine the effectiveness of the course modules. In addition, each student was distributed a satisfaction questionnaire following the completion of the post test. The questionnaire was developed with input from CORD staff, the independent evaluator, and the participating professors. As of August 2004, 289 completed surveys were received. The below table shows the number of completed surveys received for each of the six modules.

	Frequency	Valid Percent
Module 1-1: Nature and Properties of Light	58	20.1
Module 1-2: Optical Handling and Positioning	49	17.0
Module 1-3: Light Sources and Laser Safety	48	16.6
Module 1-4: Basic Geometrical Optics	43	14.9
Module 1-5: Basic Physical Optics	42	14.5
Module 1-6: Principles of Lasers	49	17.0
Total	289	100.0

Students may have completed more than one satisfaction survey if they participated in more than one module. However, within a module, students only completed one satisfaction questionnaire. The attached report includes an executive summary, detailed results for each question, and a list of all open-ended comments by module. Crosstabulations, Chi-Square tests, and ANOVA statistics are provided in the detailed results section. Within the comments section, all comments were encoded verbatim including typographical and grammatical errors committed by the respondent. This was done to preserve the integrity and context of the raw data.

Executive Summary

*Highlights of Findings From Each Section of the Report.
Recommendations for Possible Courses of Action Based on Results
are also Provided.*

Executive Summary

Background

- 289 completed questionnaires were received
- 90% of respondents were taught module content with examples
- 66% of respondents were taught hands-on laboratories
- 47% were taught end-of-module exercises

Perceived Difficulty of Modules

- 73% of respondents indicated that the number of concepts covered in the module was about right for the amount of time allotted
- 23% of respondents indicated that the number of concepts covered in the modules was too many for the amount of time allotted
- There were significant differences across modules with students having the most concerns with Module 1-4 (Basic Geometrical Optics) and Module 1-6 (Principles of Lasers); 38% and 31% of respondents thought that Module 1-4 and Module 1-6 covered too many concepts, respectively
- For each component of the modules (technical level, reading level, mathematics level, problem exercises, and hands-on laboratories), the majority of respondents rated the level of difficulty as equal compared to other texts
- With the exception of the technical level, 25% or more of the respondents rated the module components as less difficult compared to other texts
- The technical level of the modules received the highest difficulty rating with 15% of respondents rating this component as more difficult compared to the technical level of other texts
- The mathematics level of the modules received the lowest difficulty rating with 8% of respondents rating this component as more difficult compared to the mathematics level of other texts
- Although there were differences in difficulty ratings across the six modules, none reached statistical significance

Rating of Overall Quality of Modules

- 78% of respondents rated the organization of the modules as “Excellent” or “Good”
- More than 60% of the respondents rated each module component (basic concepts, figures, examples, etc.) as “Excellent” or “Good”
- Basic concepts and figures received the highest ratings while Internet-based demonstrations received the lowest rating

- There were no statistically significant differences in quality ratings among the six modules
- 89% of respondents indicated that they would recommend the use of the course modules in future classes
- Although there were differences across modules, they did not reach statistical significance
- 96% of respondents rated the supplemental guide as “Very Helpful” or “Helpful” but only 43% of respondents utilized the guide

Comments

- Respondents offered many positive comments about the organization of the modules and the associated examples and figures
- Module 1-1 received more positive comments than the other modules. However, it is not clear if this represents an order effect given that this module would have been evaluated before the others.
- The pattern of comments did appear to follow the quantitative results described earlier. For example, Module 1-5 (Basic Physical Optics) received the lowest organization rating and was least likely to be recommended compared to other modules. This module also received the fewest positive comments.
- Respondents offered a wide array of suggestions for improvements. General suggestions for improvement that appeared to apply to some degree to all modules included: the addition of a glossary, a reduction in the amount of material covered, the addition of more exercises, and a reduction in the number of formulas.
- Respondents offered many detailed module-specific suggestions for improvement

Conclusion

The majority of respondents indicated that the Step II modules were “Good” or “Excellent” and that they were comparable to other texts in terms of level of difficulty. Most students would recommend the use of the modules in future classes. Respondents offered many detailed suggestions that should be used to strengthen the current versions. The detailed results in this report should be examined carefully to ensure effective strategies for module improvement are identified. The following recommendations are intended to serve as a guide for possible courses of action based on the results described in this report:

- ***The basic concepts (text) and figures module components received the highest quality ratings. Improve the examples, hands-on laboratories, and problem exercises by ensuring they are consistent with the text and figures and that they are of the same high quality.***
- ***Consider simplifying or eliminating the Internet-based demonstrations component. This module component received the lowest quality rating compared to other components.***

- *Add an index and glossary to all modules.*
- *Improve Module 1-4 (Basic Geometrical Optics) by reducing the number of concepts covered, lowering the difficulty of the problem exercises and the hands-on laboratories.*
- *Improve Module 1-5 (Basic Physical Optics) by lowering the difficulty of the reading and mathematics levels.*
- *Improve all modules by ensuring all formulas and figures are accurately depicted.*
- *For all modules, increase the number of problem exercises and ensure that they are incorporated into instruction. Only 47% of respondents indicated that problem exercises were included in instruction.*
- *Develop a quality control plan to ensure that modules are evaluated regularly and necessary adjustments are made in a timely fashion.*
- *Although 96% of respondents thought the supplemental guide was helpful, only 43% of respondents used it. Integrate the use of the supplemental guide into all modules.*

Detailed Results

Includes Detailed Results and Analyses for Each Question

Detailed Results From Survey Questions

Parts of Module Taught. The first question assessed the degree to which the various module components were incorporated into class instruction. The table below shows the number of respondents who were taught the different parts of the course modules.

1. Please indicate which of the following major parts of the course module you were taught (mark all parts you were assigned or covered in class)

	#
Content with examples	259
End-of-module problem exercises	135
Hands-on laboratory	192

For 90% of the respondents, module instruction included module content and the associated examples. For nearly two-thirds (66%) of the respondents, the hands-on laboratories were a part of module instruction. However, the end-of-module exercises were included in module instruction for only 47% of respondents. These results show that most instructors focused on module content and examples.

Perceived Adequacy of the Amount of Material in Modules. Question 2 assessed respondent satisfaction with the amount of material covered given the allotted time. The results are shown below.

2. Based on the typical technology courses you have taken, is the number of concepts covered in this class

	Frequency	Valid Percent
too many for the time you have allotted	64	22.9
about right for the time you have allotted	204	73.1
too few for the time you have allotted	11	3.9
Total	279	100.0
No Response	10	
Total	289	

Seventy-three percent (73%) of respondents thought that the number of concepts covered was about right for the time allotted. Twenty-three percent (23%) thought that too many concepts were covered while only 4% believed that too few concepts were covered. To determine whether these findings were consistent across all six modules, a separate crosstabulation of Question 2 by module was performed. The results from this analysis are shown below.

		2. Based on the typical technology courses you have taken, is the number of concepts covered in this class			Total	
		too many for the time you have allotted	about right for the time you have allotted	too few for the time you have allotted		
module	Module 1-1: Nature and Properties of Light	Count	11	45	0	56
		% within module	19.6%	80.4%	.0%	100.0%
		% of Total	3.9%	16.1%	.0%	20.1%
	Module 1-2: Optical Handling and Positioning	Count	8	37	1	46
		% within module	17.4%	80.4%	2.2%	100.0%
		% of Total	2.9%	13.3%	.4%	16.5%
	Module 1-3: Light Sources and Laser Safety	Count	4	41	3	48
		% within module	8.3%	85.4%	6.3%	100.0%
		% of Total	1.4%	14.7%	1.1%	17.2%
	Module 1-4: Basic Geometrical Optics	Count	15	24	1	40
		% within module	37.5%	60.0%	2.5%	100.0%
		% of Total	5.4%	8.6%	.4%	14.3%
	Module 1-5: Basic Physical Optics	Count	11	30	0	41
		% within module	26.8%	73.2%	.0%	100.0%
		% of Total	3.9%	10.8%	.0%	14.7%
	Module 1-6: Principles of Lasers	Count	15	27	6	48
		% within module	31.3%	56.3%	12.5%	100.0%
		% of Total	5.4%	9.7%	2.2%	17.2%
Total		Count	64	204	11	279
		% within module	22.9%	73.1%	3.9%	100.0%
		% of Total	22.9%	73.1%	3.9%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	29.263 ^a	10	.001
Likelihood Ratio	30.723	10	.001
N of Valid Cases	279		

a. 6 cells (33.3%) have expected count less than 5. The minimum expected count is 1.58.

More than 80% of the respondents thought the first three modules covered about the right amount of material in the time allotted. For Module 1-5 (Basic Physical Optics), 73% of respondents thought the amount of material covered was about right. For Module 1-4 (Basic Geometrical Optics), 60% thought the amount of material covered was about right and 38% thought that too many concepts were covered. For Module 1-6 (Principles of Lasers), 56% of students thought the amount of material covered was about right and 31% thought too many concepts were covered. A Chi-Square test revealed that the differences in perceived adequacy of amount of material covered was statistically significant across the different modules. In terms of amount of information covered, students had more concerns with Modules 1-4 and 1-6.

Perceived Difficulty of Each Module Component. Questions 3-7 assessed perceived difficulty of module components compared to material in other course texts. The results are shown below.

Please rate the difficulty of the Step II course module compared to text material in other course texts

	More difficult		Same difficulty		Less difficult		Total	
	#	%	#	%	#	%	#	%
3. Technical level of material	44	15.2%	183	63.3%	62	21.5%	289	100.0%
4. The reading level of the material	26	9.0%	169	58.7%	93	32.3%	288	100.0%
5. The mathematics level of the material	23	8.0%	183	63.3%	83	28.7%	289	100.0%
6. The problem exercises	29	10.2%	182	63.9%	74	26.0%	285	100.0%
7. The hands-on laboratories	35	12.5%	168	60.0%	77	27.5%	280	100.0%

For each of the main module components, 60% or more of the respondents rated the modules as having the same difficulty as text materials used in other courses. When combined with the “less difficult” response, 85% to 92% of respondents rated each module as having the same or lower level of difficulty compared to other texts. For the reading level of the modules, almost a third of respondents believed it was less difficult when compared to the reading level of other texts. At least 25% of respondents thought the mathematics, problem exercises, and hands-on laboratories were less difficult compared to other texts. Twenty-two percent (22%) of respondents thought that the technical level was less difficult compared to other texts. The technical level received the highest difficulty rating with 15% of respondents rating this component as more difficult compared to the technical level of other texts. The mathematics level received the lowest difficulty rating with only 8% of respondents rating this component as more difficult compared to the mathematics level of other texts. To determine if there were any differences across modules, a series of crosstabulations and Chi-Square tests were performed. The results from each of the five crosstabulations are shown below.

module * 3. Technical level of material

Crosstab

			3. Technical level of material			Total
			More difficult	Same difficulty	Less difficult	
module	Module 1-1: Nature and Properties of Light	Count	8	36	14	58
		% within module	13.8%	62.1%	24.1%	100.0%
		% of Total	2.8%	12.5%	4.8%	20.1%
	Module 1-2: Optical Handling and Positioning	Count	7	33	9	49
		% within module	14.3%	67.3%	18.4%	100.0%
		% of Total	2.4%	11.4%	3.1%	17.0%
	Module 1-3: Light Sources and Laser Safety	Count	3	32	13	48
		% within module	6.3%	66.7%	27.1%	100.0%
		% of Total	1.0%	11.1%	4.5%	16.6%
	Module 1-4: Basic Geometrical Optics	Count	10	24	9	43
		% within module	23.3%	55.8%	20.9%	100.0%
		% of Total	3.5%	8.3%	3.1%	14.9%
	Module 1-5: Basic Physical Optics	Count	7	29	6	42
		% within module	16.7%	69.0%	14.3%	100.0%
		% of Total	2.4%	10.0%	2.1%	14.5%
	Module 1-6: Principles of Lasers	Count	9	29	11	49
		% within module	18.4%	59.2%	22.4%	100.0%
		% of Total	3.1%	10.0%	3.8%	17.0%
Total	Count	44	183	62	289	
	% within module	15.2%	63.3%	21.5%	100.0%	
	% of Total	15.2%	63.3%	21.5%	100.0%	

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	7.955 ^a	10	.633
Likelihood Ratio	8.508	10	.579
N of Valid Cases	289		

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 6.39.

For all modules, between 56% and 69% rated the **technical** level as the same difficulty as other texts. When combined with the “less difficult” response, 77% to 94% of respondents rated the technical each module as the same level of difficulty or less difficult compared to other texts. Module 1-4 (Basic Geometrical Optics) received the highest difficulty rating with 23% of respondents rating this module as more difficult compared to other texts. Module 1-3 (Light Sources and Laser Safety) received the lowest difficulty rating with only 6% of respondents rating the technical level of this module as more difficult compared to the technical level of other texts. However, the results from the Chi-Square test showed that there were no significant differences in technical difficulty ratings across the six modules.

module * 4. The reading level of the material

Crosstab

		4. The reading level of the material			Total	
		More difficult	Same difficulty	Less difficult		
module	Module 1-1: Nature and Properties of Light	Count	2	34	22	58
		% within module	3.4%	58.6%	37.9%	100.0%
		% of Total	.7%	11.8%	7.6%	20.1%
	Module 1-2: Optical Handling and Positioning	Count	4	24	21	49
		% within module	8.2%	49.0%	42.9%	100.0%
		% of Total	1.4%	8.3%	7.3%	17.0%
	Module 1-3: Light Sources and Laser Safety	Count	1	34	13	48
		% within module	2.1%	70.8%	27.1%	100.0%
		% of Total	.3%	11.8%	4.5%	16.7%
	Module 1-4: Basic Geometrical Optics	Count	4	25	13	42
		% within module	9.5%	59.5%	31.0%	100.0%
		% of Total	1.4%	8.7%	4.5%	14.6%
	Module 1-5: Basic Physical Optics	Count	7	26	9	42
		% within module	16.7%	61.9%	21.4%	100.0%
		% of Total	2.4%	9.0%	3.1%	14.6%
	Module 1-6: Principles of Lasers	Count	8	26	15	49
		% within module	16.3%	53.1%	30.6%	100.0%
		% of Total	2.8%	9.0%	5.2%	17.0%
Total		Count	26	169	93	288
		% within module	9.0%	58.7%	32.3%	100.0%
		% of Total	9.0%	58.7%	32.3%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	16.829 ^a	10	.078
Likelihood Ratio	17.532	10	.063
N of Valid Cases	288		

a. 5 cells (27.8%) have expected count less than 5. The minimum expected count is 3.79.

For all modules, between 49% and 71% rated the **reading** level as the same difficulty as other texts. When combined with the “less difficult” response, 83% to 98% of respondents rated the reading level of each module as the same level of difficulty or less difficult compared to other texts. Module 1-5 (Basic Physical Optics) received the highest difficulty rating with 17% of respondents rating this module as more difficult compared to other texts. Module 1-3 (Light Sources and Laser Safety) received the lowest difficulty rating with only 2% of respondents rating the reading level of this module as more difficult compared to the reading level of other texts. However, the results from the Chi-Square test showed that differences in perceived reading level were marginally significant but not reach significance at the .05 level.

module * 5. The mathematics level of the material

Crosstab

		5. The mathematics level of the material			Total	
		More difficult	Same difficulty	Less difficult		
module	Module 1-1: Nature and Properties of Light	Count	4	42	12	58
		% within module	6.9%	72.4%	20.7%	100.0%
		% of Total	1.4%	14.5%	4.2%	20.1%
	Module 1-2: Optical Handling and Positioning	Count	3	26	20	49
		% within module	6.1%	53.1%	40.8%	100.0%
		% of Total	1.0%	9.0%	6.9%	17.0%
	Module 1-3: Light Sources and Laser Safety	Count	1	33	14	48
		% within module	2.1%	68.8%	29.2%	100.0%
		% of Total	.3%	11.4%	4.8%	16.6%
	Module 1-4: Basic Geometrical Optics	Count	5	28	10	43
		% within module	11.6%	65.1%	23.3%	100.0%
		% of Total	1.7%	9.7%	3.5%	14.9%
	Module 1-5: Basic Physical Optics	Count	6	26	10	42
		% within module	14.3%	61.9%	23.8%	100.0%
		% of Total	2.1%	9.0%	3.5%	14.5%
	Module 1-6: Principles of Lasers	Count	4	28	17	49
		% within module	8.2%	57.1%	34.7%	100.0%
		% of Total	1.4%	9.7%	5.9%	17.0%
Total	Count	23	183	83	289	
	% within module	8.0%	63.3%	28.7%	100.0%	
	% of Total	8.0%	63.3%	28.7%	100.0%	

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	12.551 ^a	10	.250
Likelihood Ratio	12.835	10	.233
N of Valid Cases	289		

a. 6 cells (33.3%) have expected count less than 5. The minimum expected count is 3.34.

For all modules, between 57% and 72% rated the **mathematics** as the same difficulty as other texts. When combined with the “less difficult” response, 86% to 94% of respondents rated the mathematics of each module as the same level of difficulty or less difficult compared to other texts. Module 1-5 (Basic Physical Optics) received the highest difficulty rating with 14% of respondents rating the mathematics of this module as more difficult compared to other texts. Module 1-3 (Light Sources and Laser Safety) received the lowest difficulty rating with only 2% of respondents rating the mathematics of this module as more difficult compared to the technical level of other texts. However, the results from the Chi-Square test showed that there were no significant differences in mathematics difficulty ratings across the six modules.

module * 6. The problem exercises

Crosstab

		6. The problem exercises			Total	
		More difficult	Same difficulty	Less difficult		
module	Module 1-1: Nature and Properties of Light	Count	4	42	12	58
		% within module	6.9%	72.4%	20.7%	100.0%
		% of Total	1.4%	14.7%	4.2%	20.4%
	Module 1-2: Optical Handling and Positioning	Count	1	30	16	47
		% within module	2.1%	63.8%	34.0%	100.0%
		% of Total	.4%	10.5%	5.6%	16.5%
	Module 1-3: Light Sources and Laser Safety	Count	3	34	11	48
		% within module	6.3%	70.8%	22.9%	100.0%
		% of Total	1.1%	11.9%	3.9%	16.8%
	Module 1-4: Basic Geometrical Optics	Count	8	25	10	43
		% within module	18.6%	58.1%	23.3%	100.0%
		% of Total	2.8%	8.8%	3.5%	15.1%
	Module 1-5: Basic Physical Optics	Count	5	26	9	40
		% within module	12.5%	65.0%	22.5%	100.0%
		% of Total	1.8%	9.1%	3.2%	14.0%
	Module 1-6: Principles of Lasers	Count	8	25	16	49
		% within module	16.3%	51.0%	32.7%	100.0%
		% of Total	2.8%	8.8%	5.6%	17.2%
Total		Count	29	182	74	285
		% within module	10.2%	63.9%	26.0%	100.0%
		% of Total	10.2%	63.9%	26.0%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	15.017 ^a	10	.131
Likelihood Ratio	15.718	10	.108
N of Valid Cases	285		

a. 5 cells (27.8%) have expected count less than 5. The minimum expected count is 4.07.

For all modules, between 51% and 72% rated the **problem exercises** as the same difficulty as other texts. When combined with the “less difficult” response, 81% to 98% of respondents rated the problem exercises of each module as the same level of difficulty or less difficult compared to other texts. Module 1-4 (Basic Geometrical Optics) received the highest difficulty rating with 19% of respondents rating the problem exercises of this module as more difficult compared to other texts. Module 1-2 (Optical Handling and Positioning) received the lowest difficulty rating with only 2% of respondents rating the problem exercises of this module as more difficult compared to the problem exercises of other texts. However, the results from the Chi-Square test showed that the differences among modules did not reach statistical significance.

module * 7. The hands-on laboratories

Crosstab

		7. The hands-on laboratories			Total	
		More difficult	Same difficulty	Less difficult		
module	Module 1-1: Nature and Properties of Light	Count	7	38	12	57
		% within module	12.3%	66.7%	21.1%	100.0%
		% of Total	2.5%	13.6%	4.3%	20.4%
	Module 1-2: Optical Handling and Positioning	Count	2	29	15	46
		% within module	4.3%	63.0%	32.6%	100.0%
		% of Total	.7%	10.4%	5.4%	16.4%
	Module 1-3: Light Sources and Laser Safety	Count	4	29	14	47
		% within module	8.5%	61.7%	29.8%	100.0%
		% of Total	1.4%	10.4%	5.0%	16.8%
	Module 1-4: Basic Geometrical Optics	Count	10	20	12	42
		% within module	23.8%	47.6%	28.6%	100.0%
		% of Total	3.6%	7.1%	4.3%	15.0%
	Module 1-5: Basic Physical Optics	Count	7	25	8	40
		% within module	17.5%	62.5%	20.0%	100.0%
		% of Total	2.5%	8.9%	2.9%	14.3%
	Module 1-6: Principles of Lasers	Count	5	27	16	48
		% within module	10.4%	56.3%	33.3%	100.0%
		% of Total	1.8%	9.6%	5.7%	17.1%
Total		Count	35	168	77	280
		% within module	12.5%	60.0%	27.5%	100.0%
		% of Total	12.5%	60.0%	27.5%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	12.871 ^a	10	.231
Likelihood Ratio	12.953	10	.226
N of Valid Cases	280		

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 5.00.

For all modules, between 48% and 67% rated the **hands-on laboratories** as the same difficulty hands-on laboratories in other texts. When combined with the “less difficult” response, 76% to 96% of respondents rated the hands-on laboratories of each module as the same level of difficulty or less difficult compared to other texts. Module 1-4 (Basic Geometrical Optics) received the highest difficulty rating with 24% of respondents rating the hands-on laboratories of this module as more difficult compared to other texts. Module 1-2 (Optical Handling and Positioning) received the lowest difficulty rating with only 4% of respondents rating the hands-on laboratories of this module as more difficult compared to the hands-on laboratories of other texts. However, the results from the Chi-Square test showed that the differences among modules did not reach statistical significance.

Perceived Quality of Each Module Component. Questions 8-13 assessed perceived quality of each of the major module components. The two tables below show the results from this section. The first table shows the percentage of responses for each of five Likert items which ranged from “Excellent” to “Very Inadequate.” To facilitate interpretation, the second table shows the results in terms of average scores where a 5 represents “Excellent” and a 1 represents “Very Inadequate.”

	Excellent		Good		Average		Below Average		Very Inadequate		Total	
	#	%	#	%	#	%	#	%	#	%	#	%
8. Basic concepts (text)	72	24.9%	165	57.1%	40	13.8%	7	2.4%	5	1.7%	289	100.0%
9. Figures	84	29.1%	153	52.9%	45	15.6%	3	1.0%	4	1.4%	289	100.0%
10. Examples	68	23.8%	145	50.7%	65	22.7%	5	1.7%	3	1.0%	286	100.0%
11. Hands-on laboratory	62	23.6%	120	45.6%	66	25.1%	11	4.2%	4	1.5%	263	100.0%
12. Problem exercises	52	19.2%	125	46.1%	86	31.7%	4	1.5%	4	1.5%	271	100.0%
13. Internet-based demonstrations	41	19.6%	86	41.1%	73	34.9%	6	2.9%	3	1.4%	209	100.0%

Average Scores (5:Excellent - 1:Very Inadequate)

	N	Minimum	Maximum	Mean	
	Statistic	Statistic	Statistic	Statistic	Std. Error
8. Basic concepts (text)	289	1.00	5.00	4.0104	.04714
9. Figures	289	1.00	5.00	4.0727	.04592
10. Examples	286	1.00	5.00	3.9441	.04688
11. Hands-on laboratory	263	1.00	5.00	3.8555	.05421
12. Problem exercises	271	1.00	5.00	3.8007	.04949
13. Internet-based demonstrations	209	1.00	5.00	3.7464	.05905
Valid N (listwise)	199				

Between 61% and 82% of respondents rated all components as “Excellent” or “Good.” The basic concepts and figures components received the highest satisfaction ratings (82%), while the Internet-based demonstrations received the lowest rating (61%). For each module component, an ANOVA was performed to determine whether there were any differences across the six modules. Each module component represents the dependent variable while the modules represent the independent variable. The results are shown in the below tables.

Report

Module		8. Basic concepts (text)	9. Figures	10. Examples	11. Hands-on laboratory	12. Problem exercises	13. Internet-based demonstrations
Module 1-1: Nature and Properties of Light	Mean	4.0690	4.1379	4.0172	3.9107	3.8393	3.8684
	N	58	58	58	56	56	38
	Std. Error of Mean	.10100	.08678	.09681	.11754	.09796	.14690
Module 1-2: Optical Handling and Positioning	Mean	3.9388	4.0204	4.0833	3.9459	3.7660	3.7500
	N	49	49	48	37	47	32
	Std. Error of Mean	.12167	.11100	.11074	.10923	.12247	.13470
Module 1-3: Light Sources and Laser Safety	Mean	4.0417	4.1250	3.9149	3.9348	3.8889	3.8000
	N	48	48	47	46	45	40
	Std. Error of Mean	.10718	.11769	.10894	.11379	.10647	.10253
Module 4: Basic Geometrical Optics	Mean	4.0233	4.2326	4.0233	3.9268	3.8750	3.7576
	N	43	43	43	41	40	33
	Std. Error of Mean	.13097	.11923	.13097	.14563	.14844	.16872
Module 1-5: Basic Physical Optics	Mean	3.9286	3.9524	3.6667	3.5897	3.7949	3.8065
	N	42	42	42	39	39	31
	Std. Error of Mean	.09873	.11279	.11641	.17120	.12283	.14233
Module 1-6: Principles of Lasers	Mean	4.0408	3.9592	3.9167	3.7955	3.6364	3.4857
	N	49	49	48	44	44	35
	Std. Error of Mean	.13350	.13028	.12574	.13632	.13829	.17087
Total	Mean	4.0104	4.0727	3.9441	3.8555	3.8007	3.7464
	N	289	289	286	263	271	209
	Std. Error of Mean	.04714	.04592	.04688	.05421	.04949	.05905

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
8. Basic concepts (text)	Between Groups	.831	5	.166	.255	.937
	Within Groups	184.138	283	.651		
	Total	184.969	288			
9. Figures	Between Groups	2.850	5	.570	.935	.459
	Within Groups	172.624	283	.610		
	Total	175.474	288			
10. Examples	Between Groups	4.819	5	.964	1.548	.175
	Within Groups	174.286	280	.622		
	Total	179.105	285			
11. Hands-on laboratory	Between Groups	3.884	5	.777	1.005	.415
	Within Groups	198.625	257	.773		
	Total	202.510	262			
12. Problem exercises	Between Groups	1.901	5	.380	.568	.725
	Within Groups	177.339	265	.669		
	Total	179.240	270			
13. Internet-based demonstrations	Between Groups	3.176	5	.635	.869	.503
	Within Groups	148.384	203	.731		
	Total	151.560	208			

For each module component, the average satisfaction ratings across the six modules were not statistically different. For example, average scores ranged from 3.93 to 4.07 for the basic concepts components. The results from the ANOVA showed that there was a 94% probability that this small difference was due to chance. The one component that was closest to approaching significance was the examples component. Average scores for this item ranged from 3.67 (Module 1-5: Basic Physical Optics) to 4.08 (Module 1-2: Optical Handling and Positioning). The results from the ANOVA showed that there was an 18% probability that this small difference was due to chance.

Organization of Each Module Component. Question 14 assessed the perceived organization of the modules compared to other texts. The results are shown below.

14. How would you rate the organization of the module compared to other course texts?

	Frequency	Valid Percent
Excellent	80	27.8
Good	144	50.0
Average	48	16.7
Below Average	13	4.5
Very Inadequate	3	1.0
Total	288	100.0
No Response	1	
Total	289	

Seventy-eight percent (78%) of respondents rated the organization of the modules as “Excellent” or “Good” compared to other texts. To determine whether these results were consistent across all six modules, a separate crosstabulation of Question 14 by module was performed. The results from this analysis are shown below.

module * 14. How would you rate the organization of the module compared to other course texts? Crosstabulation

			14. How would you rate the organization of the module compared to other course texts?					Total
			Excellent	Good	Average	Below Average	Very Inadequate	
module	Module 1-1: Nature and Properties of Light	Count	17	29	8	4	0	58
		% within module	29.3%	50.0%	13.8%	6.9%	.0%	100.0%
		% of Total	5.9%	10.1%	2.8%	1.4%	.0%	20.1%
	Module 1-2: Optical Handling and Positioning	Count	15	22	10	2	0	49
		% within module	30.6%	44.9%	20.4%	4.1%	.0%	100.0%
		% of Total	5.2%	7.6%	3.5%	.7%	.0%	17.0%
	Module 1-3: Light Sources and Laser Safety	Count	16	24	5	2	0	47
		% within module	34.0%	51.1%	10.6%	4.3%	.0%	100.0%
		% of Total	5.6%	8.3%	1.7%	.7%	.0%	16.3%
	Module 1-4: Basic Geometrical Optics	Count	12	23	6	2	0	43
		% within module	27.9%	53.5%	14.0%	4.7%	.0%	100.0%
		% of Total	4.2%	8.0%	2.1%	.7%	.0%	14.9%
	Module 1-5: Basic Physical Optics	Count	7	21	12	2	0	42
		% within module	16.7%	50.0%	28.6%	4.8%	.0%	100.0%
		% of Total	2.4%	7.3%	4.2%	.7%	.0%	14.6%
	Module 1-6: Principles of Lasers	Count	13	25	7	1	3	49
		% within module	26.5%	51.0%	14.3%	2.0%	6.1%	100.0%
		% of Total	4.5%	8.7%	2.4%	.3%	1.0%	17.0%
Total	Count	80	144	48	13	3	288	
	% within module	27.8%	50.0%	16.7%	4.5%	1.0%	100.0%	
	% of Total	27.8%	50.0%	16.7%	4.5%	1.0%	100.0%	

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	24.842 ^a	20	.208
Likelihood Ratio	20.706	20	.415
N of Valid Cases	288		

a. 12 cells (40.0%) have expected count less than 5. The minimum expected count is .44.

Module 1-3 (Light Sources and Laser Safety) received the highest satisfaction rating with 85% of respondents rating the organization of this module as “Excellent” or “Good.” Module 1-5 (Basic Physical Optics) received the lowest rating with 67% rating the organization of this module as “Excellent” or “Good.” However, the Chi-Square test showed that the differences across modules did not reach statistical significance.

Recommend Use of Course Modules. Question 15 assessed whether students would recommend the use of the course module in future classes. The results from this question are shown below.

15. Would you recommend the use of this course module in future classes?

	Frequency	Valid Percent
Yes	255	88.9
No	32	11.1
Total	287	100.0
No Response	2	
Total	289	

Eighty-nine percent (89%) of respondents recommended the modules for future use in other classes. To determine whether these results were consistent across all six modules, a separate crosstabulation of Question 15 by module was performed. The results from this analysis are shown below.

module * 15. Would you recommend the use of this course module in future classes?
Crosstabulation

			15. Would you recommend the use of this course module in future classes?		Total
			Yes	No	
module	Module 1-1: Nature and Properties of Light	Count	52	5	57
		% within module	91.2%	8.8%	100.0%
		% of Total	18.1%	1.7%	19.9%
	Module 1-2: Optical Handling and Positioning	Count	47	2	49
		% within module	95.9%	4.1%	100.0%
		% of Total	16.4%	.7%	17.1%
	Module 1-3: Light Sources and Laser Safety	Count	44	3	47
		% within module	93.6%	6.4%	100.0%
		% of Total	15.3%	1.0%	16.4%
	Module 1-4: Basic Geometrical Optics	Count	37	6	43
		% within module	86.0%	14.0%	100.0%
		% of Total	12.9%	2.1%	15.0%
	Module 1-5: Basic Physical Optics	Count	34	8	42
		% within module	81.0%	19.0%	100.0%
		% of Total	11.8%	2.8%	14.6%
	Module 1-6: Principles of Lasers	Count	41	8	49
		% within module	83.7%	16.3%	100.0%
		% of Total	14.3%	2.8%	17.1%
Total	Count	255	32	287	
	% within module	88.9%	11.1%	100.0%	
	% of Total	88.9%	11.1%	100.0%	

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	8.186 ^a	5	.146
Likelihood Ratio	8.512	5	.130
N of Valid Cases	287		

a. 2 cells (16.7%) have expected count less than 5. The minimum expected count is 4.68.

The percentage of respondents recommending a given module ranged from 81% (Module 1-5: Basic Physical Optics) to 96% (Module 1-2: Optical Handling and Positioning). Although the results from the Chi-Square test was marginal, they did not reach statistical significance.

Use and Satisfaction with Supplemental Guide. Questions 16 and 17 assessed use and satisfaction with the module supplemental guide, respectively. The results from Question 16 are shown below.

3. Did you use the supplemental guide "Mathematics for Photonics Education" to better under this module?

	Frequency	Valid Percent
Yes	124	43.4
No	162	56.6
Total	286	100.0
No Response	3	
Total	289	

Forty-three percent of respondents indicated that they used the supplemental guide. To determine whether there were differences in usage across modules, a crosstabulation on Question 16 by module was performed. The results are shown below.

module * 16. Did you use the supplemental guide "Mathematics for Photonics Education" to better under this module? Crosstabulation

		16. Did you use the supplemental guide "Mathematics for Photonics Education" to better under this module?		Total		
		Yes	No			
module	Module 1-1: Nature and Properties of Light	Count	37	21	58	
		% within module	63.8%	36.2%	100.0%	
		% of Total	12.9%	7.3%	20.3%	
	Module 1-2: Optical Handling and Positioning	Count	21	28	49	
		% within module	42.9%	57.1%	100.0%	
		% of Total	7.3%	9.8%	17.1%	
	Module 1-3: Light Sources and Laser Safety	Count	21	26	47	
		% within module	44.7%	55.3%	100.0%	
		% of Total	7.3%	9.1%	16.4%	
	Module 1-4: Basic Geometrical Optics	Count	15	27	42	
		% within module	35.7%	64.3%	100.0%	
		% of Total	5.2%	9.4%	14.7%	
	Module 1-5: Basic Physical Optics	Count	15	26	41	
		% within module	36.6%	63.4%	100.0%	
		% of Total	5.2%	9.1%	14.3%	
	Module 1-6: Principles of Lasers	Count	15	34	49	
		% within module	30.6%	69.4%	100.0%	
		% of Total	5.2%	11.9%	17.1%	
	Total		Count	124	162	286
			% within module	43.4%	56.6%	100.0%
			% of Total	43.4%	56.6%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	14.907 ^a	5	.011
Likelihood Ratio	14.973	5	.010
N of Valid Cases	286		

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 17.78.

The percentage of respondents who used the supplemental guide ranged from 31% (Module 1-6: Principles of Lasers) to 64% (Module 1-1: Nature and Properties of Light). The results from the Chi-Square test showed that the difference in usage across modules was statistically significant.

Question 17 assessed satisfaction with the supplemental guide. Because many of the respondents did use the supplemental guide, analysis of satisfaction ratings was restricted to only respondents who indicated they had used the supplemental guide. The results are shown below.

17. Please rate the helpfulness of supplemental guide

	Frequency	Valid Percent
Very helpful	63	52.5
Helpful	52	43.3
Marginally helpful	5	4.2
Total	120	100.0
No Response	4	
Total	124	

Ninety-six percent (96%) of respondents who used the supplemental guide rated it as “Very helpful” or “Helpful.” To determine whether there were differences in satisfaction across modules, a crosstabulation on Question 17 by module was performed. The results are shown below.

module * 17. Please rate the helpfulness of supplemental guide Crosstabulation

		17. Please rate the helpfulness of supplemental guide			Total	
		Very helpful	Helpful	Marginally helpful		
module	Module 1-1: Nature and Properties of Light	Count	14	19	1	34
		% within module	41.2%	55.9%	2.9%	100.0%
		% of Total	11.7%	15.8%	.8%	28.3%
	Module 1-2: Optical Handling and Positioning	Count	9	11	0	20
		% within module	45.0%	55.0%	.0%	100.0%
		% of Total	7.5%	9.2%	.0%	16.7%
	Module 1-3: Light Sources and Laser Safety	Count	14	6	1	21
		% within module	66.7%	28.6%	4.8%	100.0%
		% of Total	11.7%	5.0%	.8%	17.5%
	Module 1-4: Basic Geometrical Optics	Count	8	6	1	15
		% within module	53.3%	40.0%	6.7%	100.0%
		% of Total	6.7%	5.0%	.8%	12.5%
	Module 1-5: Basic Physical Optics	Count	9	5	1	15
		% within module	60.0%	33.3%	6.7%	100.0%
		% of Total	7.5%	4.2%	.8%	12.5%
	Module 1-6: Principles of Lasers	Count	9	5	1	15
		% within module	60.0%	33.3%	6.7%	100.0%
		% of Total	7.5%	4.2%	.8%	12.5%
Total	Count	63	52	5	120	
	% within module	52.5%	43.3%	4.2%	100.0%	
	% of Total	52.5%	43.3%	4.2%	100.0%	

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	7.470 ^a	10	.680
Likelihood Ratio	8.265	10	.603
N of Valid Cases	120		

a. 6 cells (33.3%) have expected count less than 5. The minimum expected count is .63.

Among the students who used the supplemental guide, there were no differences in perceived helpfulness of the guide across the six different modules. The Chi-Square test showed that any difference observed did not approach significance.

Open-Ended Comments

Listing of all Comments Verbatim

Student Questionnaire for STEP II Project Comments

Module 1-1 (Nature and Properties of light)

18. What did you like most about the STEP II module?

- It was easier than some of the other books used in this course
- Easy to follow; good examples
- It explained more in better to understand examples
- Explanation is clear
- I liked the manner in which new concepts were explained visually. The figures in the book were the overall source of my understanding because they allowed me to get an adequate mental picture to the point that I could actually remember the material.
- I like the most was doing the lab on this section
- Seeing the different properties of light and of laser light
- The things I like the most was at the end of any material covered were example problems.
- The explanations given were more understandable for us, we know what was going on in the unit
- The main words in bold so a student will grasp the importance of the meaning. The mathematic examples given were very helpful
- It is very simply worded which makes it easy to understand. Lots of helpful pictures and figures.
- Above all, I like the picture models used and organization of each topic covered step by step.
- I liked the examples given because they were easy to relate with and also how the text was easy to follow and comprehend
- Easy to understand and equally difficult
- Step by step exercises; easy to understand!
- It was easy to understand and informative
- It was much easier to understand than the text book; Clearer written explanations and good diagrams.
- Hands on lab
- Thank you
- Everything I almost like
- I liked the challenge
- Very interesting
- The hands on parts
- The examples
- The pictures
- The illustrations helped to visualize the concepts
- Easy layout and easy to follow and decipher the content of the math section
- It is very easy to understand; step by step examples are great and very helpful

- The introduction, scenario, three-dimensional model opportunities for Photonics Technicians
- The reading text to understand the experiments was good!
- I like how easy it was to follow. The labs were well defined.
- I liked the mathematical examples and I thought the figures were very helpful
- The examples were excellent
- The material and examples
- Gave short & concise explanations of basic concepts.

19. What did you like least about the STEP II module?

- No index and it jumps around from one subject to another
- Needs more in depth details
- Text is too crowded
- The text and the figures were not in complete harmony with each other. The figures were good and the text was good, but they didn't quite seem to meet up with each other
- I least like was the formula Snell's law because it was kind of difficult to understand
- Hard problems
- Not enough labs
- The first module jumps straight into photonics with little description of simple explanations.
- There is not much space to write notes as we go reading through the material
- Nothing I didn't like but would want more help and information for labs.
- I think that there should be more problems for the student to perform for practice
- Nothing really, it was easy to understand
- None, well written; more examples, different examples
- Nothing
- Nothing
- Doing the mathematics
- The labs
- Need all formulas discussed written in one place at end of module for review
- Need a few more problems to go over the math sections
- There is not a complete glossary in the book (at the end)
- Need more information on several subjects to get a clear understanding. Photon- describe it with formulas and characterizing, safety and hazard classifications, wave-phase, index of refraction
- (Laboratory 1-1A) has too much explanation to make 2 measurements. This does not let the person learn about the subject. It is too much explanation. Too confusing. (Laboratory 1-1B) does not explain how to get the dimension. Very important part of experiment. 1-1C too vague.
- On page 36 & 37 d =the spacing between lines on the grating in meters. It is hard to figure out what the number is if you have 13,400 spacings per inch

- I thought going into scattering and diffraction were 2 concepts that maybe should have been introduced later, especially since they were not really related to lab exercises
- This module contained way too much information for a 1st module; While it's important to lay a good foundation you must also gain the attention and enthusiasm of the student. Spread it out some. Some pertinent information is missing
- I felt the labs made too many assumptions on the student. The steps and procedures in Lab 1-1a were very confusing. I was ultimately unclear about how to use the recorded information to find the speed of light in plastic.
- Labs 1-1A, 1.1D were not as good as they could have been.

20. Please provide any additional comments about the STEP II module.

- I prefer to take tests per units
- Try to create a better picture not just with drawings, but also with descriptive words. Example (Polarization) "Light travels like an inch worm normally does as well as like an inch worm on its side." Relate photonics to simple, everyday things
- Some of the calculations were difficult to understand at first, but they eventually made sense
- It is more easier taking test by units than taking test that might include couple of units at a time
- I believe it is a very well designed text
- Good book, well recommended
- Good book
- Overall, good learning experience
- Overall, a good module. Easier to understand than other books used in the past
- Maybe there could be a couple of blank pages at the end of each module where the exercises are for writing answers or working problems
- In Module 1-1 the student should have never had to read about Black Body Spectra; too confusing for a beginning student
- I thought it was well developed

Module 1-2 (Optical Handling and Positioning)

18. What did you like most about the STEP II module?

- The explanation of terms
- The meanings of different optical coatings
- The clarity of the formulas
- The pictures
- Explanations on some subjects are easy to understand – simple text, pictures
- Being introduce to new concepts

- Many of the things we learned about optics really interested me. Like the way coatings are deposited and the different considerations that are taken when choosing optics
- I like to laboratory information and lenses are damaged
- It was explained to me quite well, but as for the material, I don't know if it was good or bad because I know nothing about this technology prior to coming here in January
- It gave an overall concept
- The major concepts introduced
- I felt that the concepts were explained clearly, and seemed to compliment each other

19. What did you like least about the STEP II module?

- There's no space for taking notes on the book
- The mathematics of all the examples and the formulas
- The definition for Brewsters angle was not clear
- The tests
- I was unable to verify my answer for the review questions
- I did not like how the lab portion of the module was learning optics. There could have been more to it, like using the optical mounts and such
- The equations was the least that I liked
- I felt the number of concepts covered was too high, and gave only a brief summary of each one
- The information was scattered and there was not enough elaboration
- Too much information in one module. It would have been nice to go into better detail in some areas
- It was hard to follow because it was too condensed with information
- Major concepts not explained at introductory level

20. Please provide any additional comments about the STEP II module.

- Cleaning lenses is good to know
- Some words need to be defined. A glossary would help
- Good job
- Required my comment for question 19
- I think it would make a good reference guide

Module 1-3 (Light Sources and Laser Safety)

18. What did you like most about the STEP II module?

- Diagrams, tables, and scenarios
- Covers a lot of material in a brief concise manner
- The safety information and table were excellent and well thought out, the progress was good
- The figures of the eye were very helpful

- I liked the way it was presented
- The organization
- Learning the safety procedures about the eye and what rays affect it
- The wide explanation of the text we were covering
- I liked that it dealt with things that I have gone over in previous classes
- The parts of the eye and which type of light affects it
- Pictures
- How light was explained
- The labs
- The lesson
- More examples workout problems
- The use of examples and figures
- It was helpful in understanding the concepts of the chapter
- Very easy to understand
- Labs
- The charts and figures were most helpful
- Clear and easy to understand
- Easy to follow and understand; good layout
- I loved the layout of examples, the breakdown of formulas, and easy written chapter format
- Labs and examples

19. What did you like least about the STEP II module?

- Formulas on page 98
- This section could have had a lab on absorption
- The safety module III should been module 1, before any student touches a laser, laser safety should be taught and if required pounded into the head of the student; In the current book the labs in module I require the of a laser safety first not third
- Ray tracing is more advanced for entry level
- I though the lab could use a little more work
- Nothing
- There is no space in the pages to write notes as we read the text; I personally like to take notes while I'm reading
- Nothing, it was all good
- The mathematics
- Some formulas are not in this module, had to return to previous chapters
- The tests
- I did not like the way the book explained how light affects the different regions of the eye
- Needs better and more review questions
- Too short
- Lack of exercises
- Applets
- Lab B was confusing

- A little bit too much to cover in time allotted
- I wish we had a little more time to get really in depth in the theory
- Labs and examples

20. Please provide any additional comments about the STEP II module.

- The lab experiments are not more difficult they are more challenging, Challenging is a good thing
- The overall module was good
- Did not explain what distance to measure the beam diameter
- Need to explain in this module how to measure beam diameter. Did not mention anywhere at beginning of the laboratory that the detectors would have to be placed on an Optical Rail
- There are many concepts used on this module which has no meaning, such as ballats; I have no idea what they mean; providing a good glossary for each module will be helpful
- It's ok
- Not all laser categories has the power level
- This book needs an index. This book also needs a glossary
- It's better to let an instructor teach the class what he knows and having the instructor create the tests instead of having a test already written for you
- Overall very good
- A glossary in the back of the book would be helpful
- Extra sheets to do the problems at the end of the chapter on
- A few miss label or answer on the mathematical examples
- Excellent learning experience

Module 1-4 (Basic Geometrical Optics)

18. What did you like most about the STEP II module?

- Hands on lab
- I did not like the STEP II module
- The ray tracing and things like that
- The labs were very interesting and learned a lot on images
- The lab and understanding the difference between mirrors and lenses
- Thought it was very short and concise when explaining concepts; explained things well using only a few words
- A lot of pictures
- Diagrams, tables, and charts
- I liked ray tracing
- Figures
- It was very interesting and challenging to do
- Information for the module was well thought out and good. Examples are done well
- Diagrams
- I browsed our textbook also and found it a bit more confusing, where as this was more clear and effective in understanding
- Very helpful
- Awesome examples
- The descriptions

19. What did you like least about the STEP II module?

- Description on subjects were brief and complicated
- There is no index so we could refer quickly to a specific concept
- It was too much information to cover in too little time
- Too many equations and too many problems
- Too many formulas
- Can't really think of anything I didn't like in this section
- The mathematical equations and concepts were too difficult for an introductory course
- Ray tracing
- I did not like the math
- Ray tracing should not be in an entry-level book
- Too long
- It was too much too soon. If I had not had an experienced person to work with me on this chapter it would have way too hard
- This module is just too much for some one who has never seen the material; As stated before this course has much material for a first term student
- More time

- Easy to read

20. Please provide any additional comments about the STEP II module.

- This book needs a glossary, index, and review questions based on both theory and mathematic with answers for purposes of self-evaluation
- Chapter was too long
- There was not a radius of curvature formula in this module. I would suggest not to cover the material about radius of curvature in an introductory course
- This module was too advanced for beginners. Students should learn more about optics at a later time
- I had to go outside the book for an equation to complete labs
- In the labs not all of the equations provided to find the information requested
- Great for optic majors
- More exercises

Module 1-5 (Basic Physical Optics)

18. What did you like most about the STEP II module?

- Packed a lot of information into a little space; was short and to the point; explained concepts clearly
- I enjoyed the lab because it helps a little with the whole understanding of the chapter
- I like the figures and the examples
- I enjoyed the labs
- Figures and examples are helpful
- The spiral ring makes the book easy to use
- Somewhat easier to understand

19. What did you like least about the STEP II module?

- The equation for the diffraction lab does not work
- Didn't particularly like lab A
- Too many subjects or topics for one chapter; way to difficult for entry level students
- I did not like some of the math (pg. 217)
- The lab has a wrong formula on page 217 to obtain angle of laser light use

20. Please provide any additional comments about the STEP II module.

- Chapter 1-5 is way to complex and advanced; it has jumped to extreme levels of difficulty in a short amount of time
- Could not complete labs with given formulas
- The defraction grating equation was not
- This module was confusing formula's didn't work. Labs were frustrating

- On page 217 of 1-5 the formula that is given does not work for finding the wavelength. On page 218 you can not accurately approximate Brewster's angle. Need a different procedure

Module 1-6 (Principles of Lasers)

18. What did you like most about the STEP II module?

- Well, with all my classes I wasn't always able to cover everything in detail in our actual physics textbook. At times, I found it confusing even. However, this module was a lot easier to study and review for the exams.
- Examples
- Figures
- Examples
- Problems and examples
- Examples
- I found it informative and educational
- I liked the illustrations best because it helped to get a visual image of the text when trying to relate
- Well organized
- I like the exercises and labs but too complex for a starter in the program.
- The experiment was pretty good
- Good examples
- Like the way it was organized; like the fact that it covered a lot of material in a short concise way
- I like seeing figures and examples
- I liked beam divergence
- Nothing
- All of the passages in a way repeat themselves, this helps with understanding
- Learning how lasers are used in different properties and how it works
- It was like a review because this module was like the laser class I took. Only this module compressed everything to a few pages
- The types of lasers and how they work
- Mathematics involved in this module was very detailed and allowed full understanding of the techniques involved

19. What did you like least about the STEP II module?

- Short amount of time
- Text
- Speed at which it was taught
- Nothing really
- There is not a glossary in the back of the book. It would be very helpful.
- Labs
- We didn't have enough time to go over it

- The math work needs to be broken into more steps and engineering notation used when possible
- Should cover more one some examples in math equations
- The test material was not entirely covered by the chapter
- Too much in the amount of time. If you get behind its hard to catch up
- This module is far too advanced for 1st term freshman students, its too much for one semester
- Could have more lab exercises
- I did not like the math
- Too much information cramped into one chapter
- Too many complicated sentences bunched up
- This module was difficult to read. I would recommend a glossary, index, and the use of bold text instead of italicized text. I would recommend that review questions are included for purposes of self evaluation
- The equations were difficult to understand for me
- The Internet Applets did not always work nor were some helpful. Also, color pictures would have been nice in the book, that way we didn't have to strain our eyes trying to follow some of those graphs and charts
- Too much information
- That was too much information for just one chapter
- There was too much information to cover in so little time
- Some displays of laser light were reversed so rather than left-right it was displayed right-left

20. Please provide any additional comments about the STEP II module.

- It was enjoyable
- This module could have been easily broken into two modules
- Need to organize and think through better. The readings in the lab should be more
- Some of the material is not introductory level
- This module is too advanced for me. This module will be good for students that have a good background in physics and math
- Organization is great and the content is excellent; however the examples are confusing, and the labs are vague in their descriptions
- Please don't make the chapter so long because when it comes to test time the studying takes too much time
- The desire to be unique, respected, and leave a mark in the scientific community is generating rather confusing text books. Develop standards in teaching
- Show more equations involved in every example like joules = , calories = , poe = ;show the formulas

Student Questionnaire

Student Questionnaire For Step II Project

Module Title: _____

Institution: _____

Course No. and Section: _____

This questionnaire seeks your opinion of the course module listed at the top of this page. Your responses will be used to assess satisfaction with module content, organization, difficulty, and general effectiveness. The results from the questionnaire will be used to make improvements in the course module. *Please use a No. 2 pencil.*

1. Please indicate which of the following major parts of the course module you were taught (*Mark all parts you were assigned or covered in class*)

- 0 Content with examples
- 1 Hands-on laboratory
- 2 End-of-module problem exercises

2. Based on the typical technology courses you have taken, is the number of concepts covered in this module

- 0 too many for the time you have allotted
- 1 about right for the time you have allotted
- 2 too few for the time you have allotted

Please rate the difficulty of the Step II course module compared to text material in other course texts.

▼
More
Difficult
▼
Same
Difficulty
▼
Less
Difficult

- 3. Technical level of the material
- 4. The reading level of the material
- 5. The mathematics level of the material
- 6. The problem exercises
- 7. The hands-on laboratories

<input type="radio"/> 0	<input type="radio"/> 0	<input type="radio"/> 0
<input type="radio"/> 0	<input type="radio"/> 0	<input type="radio"/> 0
<input type="radio"/> 0	<input type="radio"/> 0	<input type="radio"/> 0
<input type="radio"/> 0	<input type="radio"/> 0	<input type="radio"/> 0
<input type="radio"/> 0	<input type="radio"/> 0	<input type="radio"/> 0

Please rate the overall quality of each component of the Step II course module.

▼
Excellent
▼
Good
▼
Average
▼
Below
Average
▼
Very
Inadequate
▼
Not
Applicable

- 8. Basic concepts (text)
- 9. Figures
- 10. Examples
- 11. Hands-on laboratory
- 12. Problem exercises
- 13. Internet-based demonstrations (Applets)

<input type="radio"/> 0	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3	<input type="radio"/> 4	<input type="radio"/> 5
<input type="radio"/> 0	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3	<input type="radio"/> 4	<input type="radio"/> 5
<input type="radio"/> 0	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3	<input type="radio"/> 4	<input type="radio"/> 5
<input type="radio"/> 0	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3	<input type="radio"/> 4	<input type="radio"/> 5
<input type="radio"/> 0	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3	<input type="radio"/> 4	<input type="radio"/> 5

14. How would you rate the organization of the module compared to other course texts?

- 0 Excellent
- 1 Good
- 2 Average
- 3 Below Average
- 4 Very Inadequate

15. Would you recommend the use of this course module in future classes?

- 0 Yes
- 1 No

16. Did you use the supplemental guide "Mathematics for Photonics Education" to better understand this module?

- 0 Yes
- 1 No

17. If you answered Yes to Question 15, please rate the helpfulness of the supplemental guide in terms of your understanding of the math and technical concepts included in this module.

- 0 Very helpful
- 1 Helpful
- 2 Marginally helpful
- 3 Not helpful

Comments

18. What did you like most about the Step II module?

19. What did you like least about the Step II module?

20. Please provide any additional comments about the Step II module.

Thank you for your participation in this questionnaire.