

# Contents

<b>1</b>	<b>Introduction</b> .....	<b>1</b>
<b>2</b>	<b>The Nature and State of the Undergraduate Chemistry Lab</b> .....	<b>3</b>
2.1	Lab Course Instruction Styles .....	4
2.2	Implementation into the Curriculum .....	6
2.3	Lab Courses' Contribution to Learning Chemistry and Academic Success ...	8
<b>3</b>	<b>Theories on Laboratory-Supported Learning</b> .....	<b>13</b>
3.1	Prior Knowledge and Laboratory Instruction .....	13
3.2	Lab Course Learning Goals and Learning Goal Alignment .....	19
3.3	Models on the Effectiveness of Practical Work .....	22
3.4	Model on Influencing Factors for Lab Course Success .....	26
<b>4</b>	<b>Research Questions and Hypotheses</b> .....	<b>29</b>
<b>5</b>	<b>Study Design</b> .....	<b>31</b>
5.1	Study Context and Sample .....	31
5.2	Assessed Variables and Test Instruments .....	35
5.2.1	Content Knowledge .....	36
5.2.2	Lab Skills .....	37
5.2.3	Learning Goal Alignment and Learning Goal Perceptions .....	43
5.2.4	Background and control variables .....	47
5.3	Data matching .....	49
<b>6</b>	<b>Methodology for Data Analysis</b> .....	<b>51</b>
6.1	Content Knowledge and Lab Skills (Paper-Pencil Test Data) .....	51
6.2	Learning Goal Alignment and Perceptions (Rating Scale / Ranking Data) ..	55
6.3	Hands-On Lab Skills (Observation Sheets and Video Data) .....	59
<b>7</b>	<b>Pilot Study</b> .....	<b>63</b>
7.1	Sample .....	65
7.2	Pilot Study 1 .....	66
7.2.1	Results and Discussion .....	66
7.2.2	Test Revision for Pilot Study 2 .....	74

7.3	Pilot Study 2 .....	75
7.3.1	Results and Discussion .....	76
<b>8</b>	<b>Main Study .....</b>	<b>81</b>
8.1	Final test instruments and test parameters .....	82
8.1.1	Content Knowledge.....	83
8.1.2	Lab Skills (Paper-Pencil Test).....	85
8.1.3	Lab Skills (Hands-On).....	86
8.1.4	Learning Goal Alignment and Learning Goal Perceptions .....	88
8.1.5	Background and control variables.....	89
8.2	Sample.....	90
8.3	Results and Discussion .....	94
8.3.1	Students' Learning Goal Expectations and Perceptions over Time ..	94
8.3.2	Learning Goal Alignment between Students and Lab Instructors ..	101
8.3.3	Prediction of Lab Course Success .....	103
8.3.4	Effect of Lab Course Enrolment on Learning Chemistry.....	106
8.3.5	Relationship between Lab Course and General Chemistry Final Exam ..	108
<b>9</b>	<b>Implications for Research and Teaching .....</b>	<b>111</b>
<b>10</b>	<b>Conclusion .....</b>	<b>117</b>
<b>11</b>	<b>References and Lists .....</b>	<b>121</b>
11.1	Bibliography .....	121
11.2	List of Figures .....	131
11.3	List of Tables.....	133
	<b>Appendix .....</b>	<b>137</b>