PLANTING A VIRTUAL VINEYARD: USING PROBLEM-BASED LEARNING TO EXAMINE THE IMPORTANCE OF SITE SELECTION TO PREMIUM WINE GRAPE PRODUCTION IN WASHINGTON STATE

By

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A thesis submitted in partial completion of
the requirements for the degree of

MASTER OF SCIENCE IN HORTICULTURE

WASHINGTON STATE UNIVERSITY
Department of Horticulture and Landscape Architecture

AUGUST 2007

To the Faculty of Washington State University:

The members of the Committee appointed to examine the thesis of KATHRYN L. HOUSE find it satisfactory and recommend that it be accepted.

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Chair

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ACKNOWLEDGEMENTS

First and foremost, 1 would like to thank my advisor, Dr. Kathleen Willams, for her support and guidance. It is her vast knowledge of viticulture, gracious assistance, wonderful hospitality and solid friendship that enables me to complete this thesis. My committee members Drs. Bhaskar Bondada and Markus Keller for their patience, advice, and encouragement with this project. The Washington wine industry for their provision of assistance with the survey and especially director Vicky Scharlau for her support of the project.

I would like to extend my deepest appreciation to my amazing friends Darlene and Greg Neunherz for everything from our late night debates to our early morning home improvement projects. My stepmother Leticia House for serving as a patient and kind example in all situations. Dr. Keri Luft for being a true sister to me from veterinary school to winemaking and beyond. Bob, Cathy and Carmen Betz for being so encouraging of my education efforts in and out of the classroom and serving as my long lost "Italian family". Each of you has been instrumental to my current successes in and out of the classroom.

Daniel McClaskey for his unwavering patience and "necessary grounding" to keep me sane. I could never have finished this thesis without your loving guidance and gentle prodding. You kept me on track even when I was on the edge of falling off a cliff… or two. Last in this list, but always first in my heart, my father Craig House for his inspiration and encouragement of my following in his footsteps by pursuing work in the wine industry. From my childhood dreams of being a veterinarian to my grown-up dreams of grape growing and winemaking, you've been my biggest champion. I hope to enjoy the opportunity to continue your legacy of curiosity and love of life for as long as I live!

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Abstract

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August 2007

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During the last three decades, the Washington state wine grape industry has grown from a mere few thousand acres and nineteen wineries to over thirty-thousand acres and over four hundred wineries. Moreover, an initial assessment of the industry indicated an overriding need for qualified employees in the viticulture, enology, and business sectors. In response to this booming commerce sector, the Viticulture and Enology program at Washington State University was created in 2001 to train graduates to fill such positions. However, concerns with curricula applicability and distance course delivery as well as lack of adequate compensation for industry positions had arisen. This research sought to reassess industry and student needs in conjunction with outlined program goals thus modifying the program curricula to increase effectiveness for industry members, students, and program instructors.

An extensive industry survey highlighting the preferred positions, knowledge, skills, and pay scale for graduates of a baccalaureate degree program indicated that qualitative skills such as communication and problem-solving ability were required for success in the industry in addition

to subject-specific knowledge areas. Therefore, in lieu of exams, a series of collaborative, problem-based learning exercises were implemented on a trial basis in an Advanced Viticulture course to aid in students' subject and qualitative skill development. Proven to be effective for similarly complex educational areas such as medicine and law, course modules utilized industry relevant and research-based data. While formulating a "Virtual Vineyard" proposal for a fictitious client, student "consulting" groups learned to integrate essential subject specific knowledge while increasing their proficiency in problem-solving, team work, communication, and leadership. Performance and perception results of the Virtual Vineyard modules indicated that student achievement increased as familiarity with the exercises increased. Furthermore, students rated the Virtual Vineyard highly due to its problem-based learning and real world application. Results of this research will be utilized for the enhancement of the Viticulture and Enology Program at Washington State University and will be shared with state industry organizations.

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Background of Viticulture and Enology education in Washington State. In the last twenty-five years the Washington state wine industry has grown from a small niche industry to one of major economic importance for the state as well as the nation. Today, over 30,000 acres of wine grape plantings and 460 wineries exist in Washington State and new production facilities are added almost weekly (USDA 2006, USDA 2007, WWC 2006). Furthermore, in 1998 Washington became the second largest wine grape producing state in the nation by increasing production past that of the former second place state, New York. While only 19 wineries were located in Washington in 1981, by 1999 this number had increased to over 151 wineries (WWC 2006). Similarly, wine grape acreage more than doubled to a total of 24,000 acres in 1999 from a mere 11,000 acres in 1993 (Perez 2000).

In response to increased wine grape acreage and wine production, the Washington State Wine Commission created the Washington Viticulture and Enology Education Consortium in 1999 (WSU V&E 2006) . The goal of this project was to form a cooperative higher education system wherein viticulture and enology education could be fostered at the university level as well as at associated community colleges. Thus, the industry would be able to not only attract and hire employees educated in Washington and provide continuing education for those currently employed in the wine industry, but also further the knowledge base of the industry as a whole. Washington State University along with Yakima Valley, Walla Walla, Wenatchee and Columbia Basin Community Colleges developed an educational agenda to create a university-level Bachelor of Science degree in Viticulture and Enology with articulation agreements from each of the associated community colleges. In this way, students currently employed in the industry could study viticulture and enology at the nearest associated community college for two years

and then transfer to WSU for the remaining two years of study required to obtain a baccalaureate degree (Hatch 2003).

With an emphasis not only on knowledge but also on practical competency in viticulture and enology, the Washington Wine Commission helped fund the first industry needs assessment to complement these emerging viticulture and enology education programs in Washington State (Folwell and Cembali 2001). Completed and published by Folwell and Cembali in 2001, the goal of this mail-in survey was to determine the perceived industry demand for employees skilled in wine grape growing in Washington and wine production across the Pacific Northwest based upon various education stratifications. Furthermore, the expected general skills and competencies of employees hired into specific positions were investigated (Folwell and Cembali 2001).

Although only substantial data from Washington and British Columbia, Canada were received, results of the report indicated that a need did exist for future employees in vineyard and winery positions with baccalaureate, community college as well as continuing education certificates and degrees (Folwell and Cembali 2001). However, the expected annual demand for employees was highly variable depending upon the education degree obtained as well as the overall outlook of the industry. The five-year estimated annual demand for future employees with a bachelors degree ranged from 16 to 40 new hires, 22 to 54 for community college educated employees and between 904 and 3,198 for those with solely a high school education (Folwell and Cembali 2001).

Specific demands for employees who had obtained bachelor's degrees were then further divided into specific vineyard and winery related positions. The primary demand for vineyard employees with a baccalaureate degree was limited to the positions of vineyard manager and

viticulturists such that an annual demand forecast of 7 to 29 new hires per year until 2006 was given (Folwell and Cembali 2001). Conversely, a greater number of winery positions were determined to require a 4-year degree including general manager or vice president of production, production manager, winemaker, and assistant winemaker. However, the number of actual positions available was limited with only an average of 9 to 11 new positions expected per year until 2006 (Folwell and Cembali 2001).

History of the Washington State University Viticulture and Enology program. Based on the results of the education consortium meetings, the completed needs assessment survey of the wine industry, as well as advisement by a board of directors which included appointees from academia, industry and the WSU administration, a framework for the degree was developed. General education requirements such as math, English and social science courses were included to ensure well-rounded graduates. Furthermore, important mid-level foundational science courses including chemistry, entomology, soil science, plant physiology and horticulture were required. Internship requirements were added to ensure that graduates were able to excel in intellectual as well as practical competency. Given the industry's desire to have the program available to current place-bound employees in the wine industry, it was determined that courses would be offered via video telecommunications from the main Pullman campus to the Tri-cites satellite campus.

In addition to these pre-existing courses, three new senior and graduate-level wine specific courses were added: advanced viticulture, wine chemistry, and wine microbiology. Although taught by different instructors with varied teaching styles a traditional lecture format was adopted for all courses. In the wine microbiology and wine chemistry courses two mid-terms exams, one special topic paper and a final exam were utilized as gauges for student

involvement and assessment while the Advanced Viticulture course utilized a similar structure with two mid term exams and a final project.

By the Spring of 2005, the first official graduates of the program were set to begin the last year of their university degree. While four students at the Tri-Cities campus had completed the wine education requirements in 2004 and received a Bachelors of Science degree in agriculture with an emphasis in viticulture and enology at that time, not one student had "officially" graduated from the program with a Bachelor of Science degree in viticulture and enology. Still in its infancy, many industry members were familiar with the WSU program as many of the future graduates had completed internships in the field and a handful of university graduates from other majors held positions in the industry. Yet, questions as to the preparedness of students for employment in the Washington wine industry as well as the general job outlook for bachelor degree graduates in viticulture and enology remained.

Despite positive press articles from numerous local news sources and general support for the program, the four students who had completed the viticulture and enology courses and graduated with bachelor degrees in agriculture were found to initially have a difficult time gaining full-time positions after graduation (Issacs 2004). Furthermore, those that were offered permanent positions encountered lower than expected salaries after graduation. To date, of the four initial graduates, only one continues to work directly in grape and wine production despite expectations of being offered enology positions post graduation (Issacs 2004).

To address the afore-mentioned concerns cited by industry and education partners, the Virtual Vineyard project was developed. Divided into two parts, the overreaching goals of this project were to:

1. Ascertain the current employment climate and employer expectations in the industry for university graduates via an industry survey.
2. Improve course applicability through an experimental modification of the curriculum of the Advanced Viticulture course at Washington State University.

To ensure that the knowledge and skills necessary for success in the industry were being addressed by the WSU program, a cooperative industry survey was conducted in the spring of 2005 to assess training, knowledge and university graduate skill expectations of employers in the Washington State wine industry. Divided into viticulture, enology and business industry segments, key areas of emphasis were determined. Chapter one describes the specific goals, methodology and results of the industry survey conducted in the spring of 2005.

The results of the survey also included determination of the five most important viticulture knowledge areas and essential qualitative skills as determined by industry members. In turn, these topics were integrated into the curriculum of the Advanced Viticulture course at Washington State University such that key areas of importance were further emphasized. This modification was embodied via the development of an experimental learning approach not currently used in the viticulture and enology curricula. Chapter two details the background research, course implementation and student and faculty results of this work.

An integrated discussion of these two chapters is included in the summary section. The applicability of both portions of the project to the current and future baccalaureate education program in enology and viticulture provided by Washington State University are analyzed as well.

CHAPTER 1: INDUSTRY ASSESSMENT

INTRODUCTION

Review of 2001 needs assessment of Washington State Viticulture and Enology education. The survey conducted and published by Folwell and Cembali in 2001 included substantial data from Washington and British Columbia, Canada. Results of the report indicated that a need did exist for future employees in vineyard and winery positions with bachelors, community college as well as continuing education certificates and degrees. However, the expected annual demand for employees was highly variable depending upon the education degree obtained as well as the overall outlook of the industry. The five-year estimated annual demand for future employees with a bachelors degree ranged from 16 to 40 new hires, 22 to 54 for community college educated employees and between 904 and 3,198 for those with solely a high school education (Folwell and Cembali 2001).

Specific demands for employees who had obtained bachelors degrees were then further divided into individual vineyard and winery related positions. The primary demand for vineyard employees with a 4-year degree was limited to the positions of vineyard manager and viticulturists such that an annual demand forecast of 7 to 29 new hires per year until 2006 was given (Folwell and Cembali 2001). Conversely, a greater number of winery positions were determined to require a baccalaureate degree. Positions titles included general manager or vice president of production, production manager, winemaker, and assistant winemaker. However, the number of actual positions available was limited to only an average of 9 to 11 new positions expected per year until 2006 (Folwell and Cembali 2001).

In addition to specific positions and five-year forecasting of job availability for baccalaureate degree graduates, Folwell and Cembali's study also polled the vineyards and

wineries to determine their expectations of individual skill levels for new hires. In the winery, the general manager and production manager positions were required to have similar skill sets with the general manager having a greater depth of knowledge of business aspects such as marketing and sales and financial planning (Folwell and Cembali 2001). Conversely, the production manager was expected to excel in most practical areas of viticulture, enology, and laboratory analyses. The highest skill competency expectations overall were for winemakers, which included the highest scores in fruit quality assessment, wine microbiology and chemistry, wine evaluation, barrel knowledge, aging, racking, quality control, as well as all laboratory skills and research techniques (Folwell and Cembali 2001).

Similar skill set results were apparent in vineyard employment as well. Despite overall competency requirements, minor differences in the vineyard positions of manager and viticulturist existed. Expectations of increased competencies in the areas of supervision, written communication, canopy management, and crop load analysis for the manager position were apparent. Alternately, future viticulturists were expected to have a greater knowledge of pests, diseases, and nutrients as well as comparable fruit quality and development determinations (Folwell and Cembali 2001).

This survey was an essential step in the development of the viticulture and enology baccalaureate degree at Washington State University as not only did the survey quantify the number of future employees needed to meet prospective wine industry demand, it also determined the basic skills and education level expected of these individuals. However, issues such as low response rate, lack of respondent demographic data and high score variance countered some of positive results found.

Only forty-three respondents from wineries and vineyards across Washington responded out of the over 300 mailed surveys. In addition, the qualifications of the respondents were simply that they were associated with a winery and/or vineyard. Validity of the respondents' answers as qualified by their familiarity of the industry segment was not available. For instance, had a tasting room manager of a small non-estate winery answered questions regarding viticulture positions despite having limited knowledge of this aspect of the industry, the results could be deemed practically invalid. Score variance was utilized to counter this effect. However, several positions had significant overlapping of the depth of skill competencies such that distinct differences in qualifications were difficult to determine.

In conjunction with these issues, and the graduation of the first baccalaureate degree graduates four years later, questions not addressed via this survey yet essential to the education and success of future 4-year degree graduates entering the wine industry were apparent. In regard to graduate-centric data, more specific information regarding job outlook and expectations for new hires needed to be available. Specific information such as industry-driven salary scales for common wine industry positions available to graduates, expectations as to the number of internships expected prior to full-time employment, and amount of "on the job" training provided was required as well.

In addition, given the limited time available for degree coursework, program administrators and course instructors must understand the industry's perception of vital instructional topics. Thus, key knowledge areas and qualitative skills required for success in the viticulture, enology, and business sectors of the wine industry remained to be determined. In response to this demand and a desire to increase the effectiveness of the WSU Viticulture and Enology Program, this new survey was created to address these issues.

RESEARCH DESIGN AND METHODOLOGY

An online wine industry survey was created in the Fall of 2004 and released in the spring of 2005. Intended to build upon the results of the survey completed by Folwell and Cembali in 2001, this questionnaire was created to address questions of salary and prospective employer expectations that directly affect long-term student success (Appendix A). The primary goals of the wine industry survey were to:

1. Determine the types of positions and associated salaries for university graduates entering the wine industry.
2. Ascertain the expected and provided job training for potential positions.
3. Discover the most essential knowledge and qualitative skill sets needed for success by future university graduates.

Following its creation, two major revision sessions were conducted with Dr. Raymond Folwell and his assistant Trent Ball to increase the survey's readability and applicability. A final revision was conducted with representatives of the viticulture and enology faculty and research departments as well as a multimedia specialist to review and translate the survey to an online format.

Eight questions were further divided into four major sections: 1) prospective position salary range, 2) essential qualitative and quantitative skills, 3) expected employee competency, and 4) previous internship experience of prospective university graduate employees. Each question section was further applied to business, enology and viticulture factions distinctly such that differences between the requirements of each could be analyzed (Appendix A). In conjunction with the four survey sections data provided about the participants included company size as related to grape acreage as well as wine production and the specific job title of the

respondent. This was done to quantify any biases toward specific industry segments or production sizes. For ease of use, salary questions responses were composed of a range of salaries in $5,000 increments with the first category encompassing all salaries below $20,000 and the final response group including all salaries of $70,000 or greater.

The survey was initiated on February 2, 2005 and closed May 1, 2005. Industry respondents were primarily attendees of the annual Washington Association of Wine Grape Growers (WAWGG) 2005 convention. Numerous announcements by conference organizers were made throughout the conference and a presentation was given at the annual member breakfast to encourage industry participation. Additionally, an advertising booth complete with two laptop computers for survey completion and cards detailing the survey goal, contact information and website were distributed. Advertising links on the Washington Wine Grape Growers website (http://www.wawgg.org) and the Washington State University Wine website (http://fruit.wsu.edu/Grapeweb/grapeweb.htm) were also posted to increase industry response. Voluntary participants were requested to complete the survey to the best of their ability. More than one employee from a winery or vineyard was permitted to complete the survey as it was expected that those differing in job title may have distinct yet equally valuable perceptions of the most fitting positions and associated skills of university graduates. Respondents were given the option to not answer specific questions of which they felt unqualified to respond. This option was suggested to decrease instances wherein respondents unprepared to answer the given questions would provide responses merely for the sake of completing the survey.

The primary goal of the research was simply to determine the most frequent responses to make broad generalizations about the state of the employment in the industry rather than make inferences as to the specifics of such results. Therefore, descriptive statistics such as

percentages, means, medians and modes of responses were the primary statistical tests utilized. Post-analysis inferential statistics such as Chi-squares and Pearson's tests were considered but not utilized. The substitution of a random sample of respondents for those readily available and involved in the industry also strongly favored descriptive statistics rather than inferential statistics which are more applicable to randomly selected samples. This decision was made to keep results from being over-generalized, thus making tenuous conclusions about the results.

RESULTS

Wine industry survey respondent demographics. A total of fifty-one respondents completed the survey from February 2, 2005 to May 3, 2005. Demographic information was collected to qualify the results of the survey in conjunction with the current condition of the Washington State wine industry based upon congruent statistical reports. Results indicated that the majority of respondents were from small vineyards of less than fifty acres or wineries without estate vineyards (Table 1). Similarly, the majority of respondents worked for companies that produced less than 5,000 9-liter cases annually or were solely involved in either viticulture or enology (Table 1). Confounding of these results due to the lack of "not applicable" answer choice in both questions regarding vineyard and winery production size occurred. Therefore, determination of a true number of individuals in either vineyard or winery production was difficult as those at a small scale operation and those not involved at all in the segment were mistakenly grouped together.

Given the diversity of size of the Washington wine industry and the expected overlap between viticulture, enology and business sectors of the market, participants were given the opportunity to list themselves as having one position in each of these industry divisions. In this

way, each respondent listed could have indicated affiliation with three distinct industry positions. While most participants chose only one specific job category, eleven of the contributors chose two or more positions. Thus, while the total number of respondents was 51, the total number of positions listed was 100 (Table 2).

Table 1. Number and Associated Percentage of 2005 Washington Wine Industry Education Survey Respondents Based Upon Size of Operation

Operation Size	# of Responses	%
Vineyard (acres)		
0-25	25	49
26-50	9	18
51-100	5	10
101-200	4	8
201- 400	2	4
Greater than 400	6	12
Total Responses	51	100
Winery (cases)		
0-5,000	35	68
5,001 to 10,000	3	6
10,001 to 25,000	8	16
25,001 to 40,000	0	0
Greater than 40,000	5	10
Total Responses	51	100

While the majority of the respondents identified themselves as having some position related to enology, results showed that the number of respondents were approximately equal in representing viticulture, enology and business sectors. Roughly one third of respondents were associated with viticulture, one third with enology, one third with business and the remainder held "other" positions (Table 2). These results validated the evaluation of all three sectors as being equally representative of their respective populations as to sample size.

Table 2. Demographic Positions of Respondents from the 2005 Washington Wine Education Survey

Respondent Industry Position	# of Responses	% Responses Category	% Responses Total
Viticulture			
Viticulturist	10	53	15
Vineyard Manager	9	47	14
		100	**29**
Enology			
Lead Winemaker	12	52	18
General Manager or Vice President of Production (V.P.)	4	17	6
Assistant Winemaker	4	17	6
Production Manager	1	4	2
Cellarmaster	2	9	3
		100	**35**
Business			
Owner/ Chief Executive Officer (C.E.O)	14	78	20
Sales Manager	2	11	3
Chief Financial Officer (C.F.O)	1	5.5	2
Marketing Director	1	5.5	2
		100	**27**
Other	6		**9**
Total Responses	**66**		**100**

Of the viticulture positions, approximately half were vineyard managers and half identified themselves as viticulturists indicating that respondents in primarily management as well as viticulture roles were equally represented (Table 2). Lead winemakers were the highest respondents from the enology sector followed by general managers and assistant winemakers. Few cellarmasters and production managers also responded at the rate of two and three respondents respectively. Company owners comprised the largest group of business respondents with approximately 20% of the overall survey respondents while C.F.O's, sales managers and marketing directors also responded. All the respondents from the viticulture and business sectors,

as well as the vast majority of the respondents in the enology section held a mid to high-level management position in their wine industry sector. Therefore, the issue of survey accuracy due to limited respondent knowledge can be reasonably eliminated.

Suggested areas of preferential hiring of university graduates in the wine industry. In the first questionnaire section, respondents rated those positions in which they would prefer to hire a university viticulture and enology program graduate as well as the associated salary for each position. No distinction was made between recent graduates and those with more experience as further questions in the survey addressed this issue via the number of internships requested by employers prior to employment. Of the viticulture positions, vineyard manager, viticulturist, assistant viticulturists, irrigation managers and crew supervisors were indicated as being positions of preferential hire for university graduates. Salary scales revealed the mean vineyard manager salary range proposed by respondents was $37,000 to $42,000 with a large amount of variation of salaries from the lowest category of salaries at less than $19,000 and a high salary category of $70,000 or greater. The viticulturist salary scale was similar with a salary range cap of $60,000 to $65,000 with a mean salary range of $35,000 to $40,000 (Figure 1). The assistant viticulturist position mean salary range was $27,000 to $32,000 with a smaller variation of less than $19,000 to a maximum of $39,000 while an irrigation manager was suggested to earn a mean salary range of approximately $30,000 to $35,000 with a high salary of $55,000 (Figure 1). Finally, the mean crew manager salary range $25,000 to $30,000 with the highest salary of $45,000 (Figure 1).

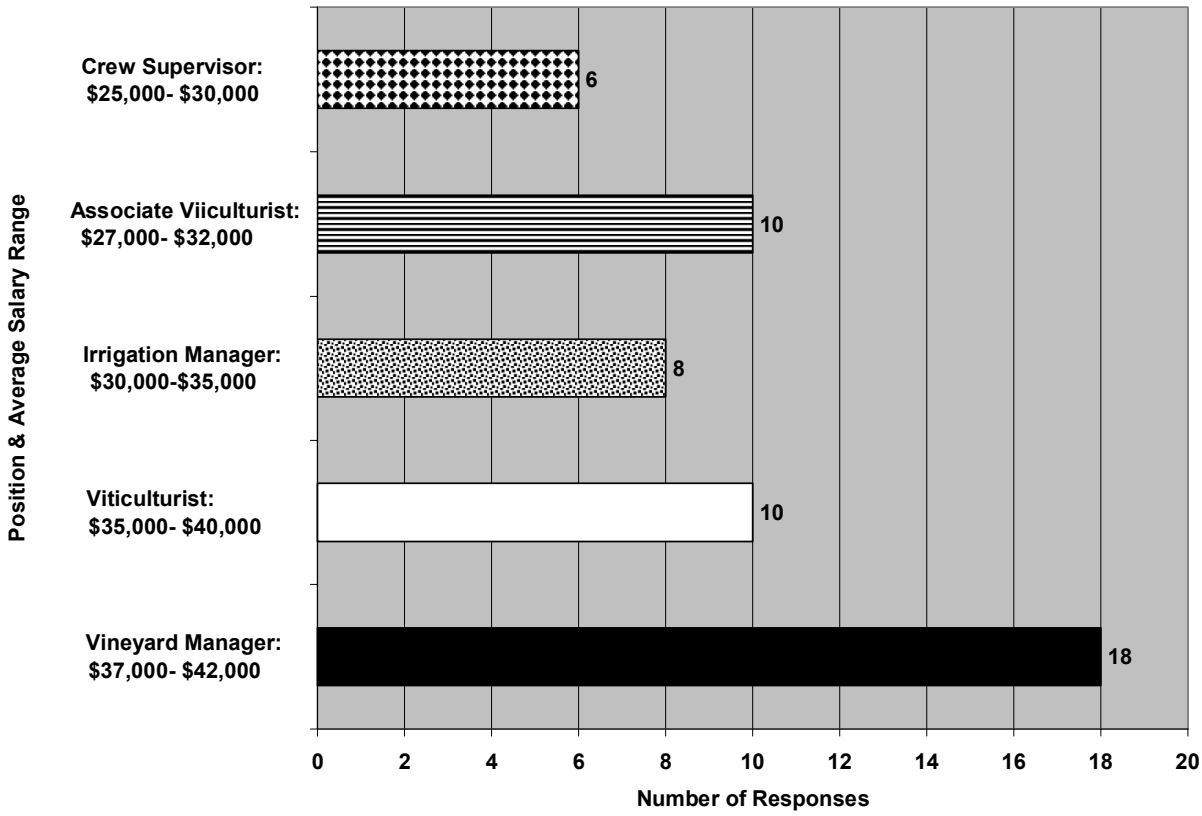

Figure 1: Suggested Viticulture Positions and Salaries for Prospective V&E University Graduates Working in Washington State, 2005

Enology salaries were found to be slightly higher overall than those of the viticulture section. General managers and vice-presidents of production were suggested to earn a maximum of $70,000 or more with a mean range of $50,000 to $55,000 while production manager salaries had a maximum of $55,000 with an average proposed salary range of $35,000 to $40,000 (Figure 2). Lead winemakers were proposed to have average salaries of $50,000 to $55,000 with a total range of suggested salaries from $35,000 to $65,000 while assistant winemakers could expect a mean pay scale range of $30,000 to $35,000 with a total range between $20,000 and $45,000 annually (Figure 2). Lastly, laboratory technicians holding a bachelors degree were suggested to earn an average salary range of $25,000 to $30,000 with an overall range of $20,000 to $40,000

while cellar masters of the same education standing were proposed to earn an average range of $25,000 to $30,000 within an overall range of $20,000 to $45,000 (Figure 2).

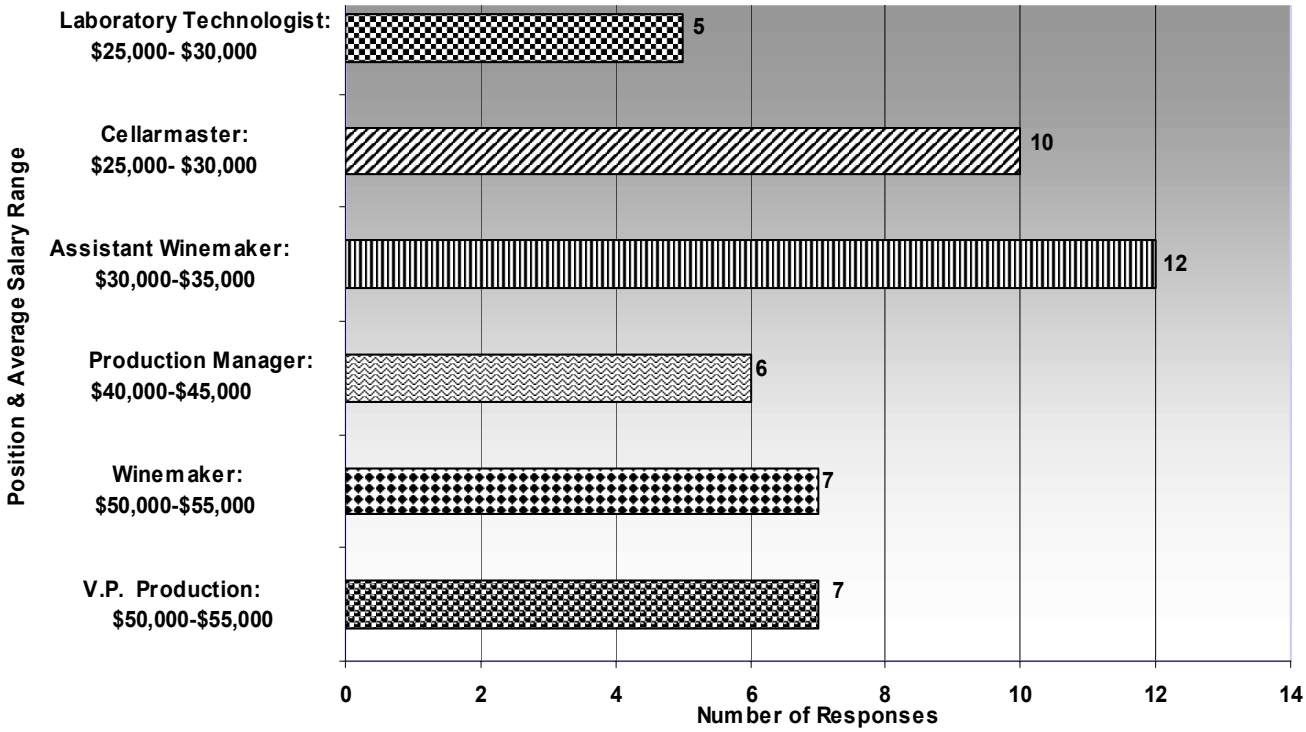

Figure 2: Suggested Washington State Enology Positions and Salaries for University Graduates, 2005

Of all sectors of the wine industry, the business component salaries were found to be the highest. The prospective most highly paid position was company CEO with a $70,000 plus average salary proposed and a range of $40,000 to more than $70,000 annually (Figure 3). Marketing directors holding a bachelors degree were suggested to earn an average of $50,000 with an overall range of $35,000 to $70,000 per year. Public relations coordinators could expect an average salary of $45,000 with an overall range of $35,000 to $65,000 while sales managers had a slightly higher average salary of $50,000 with a larger range of $20,000 to $70,000 annually (Figure 3).

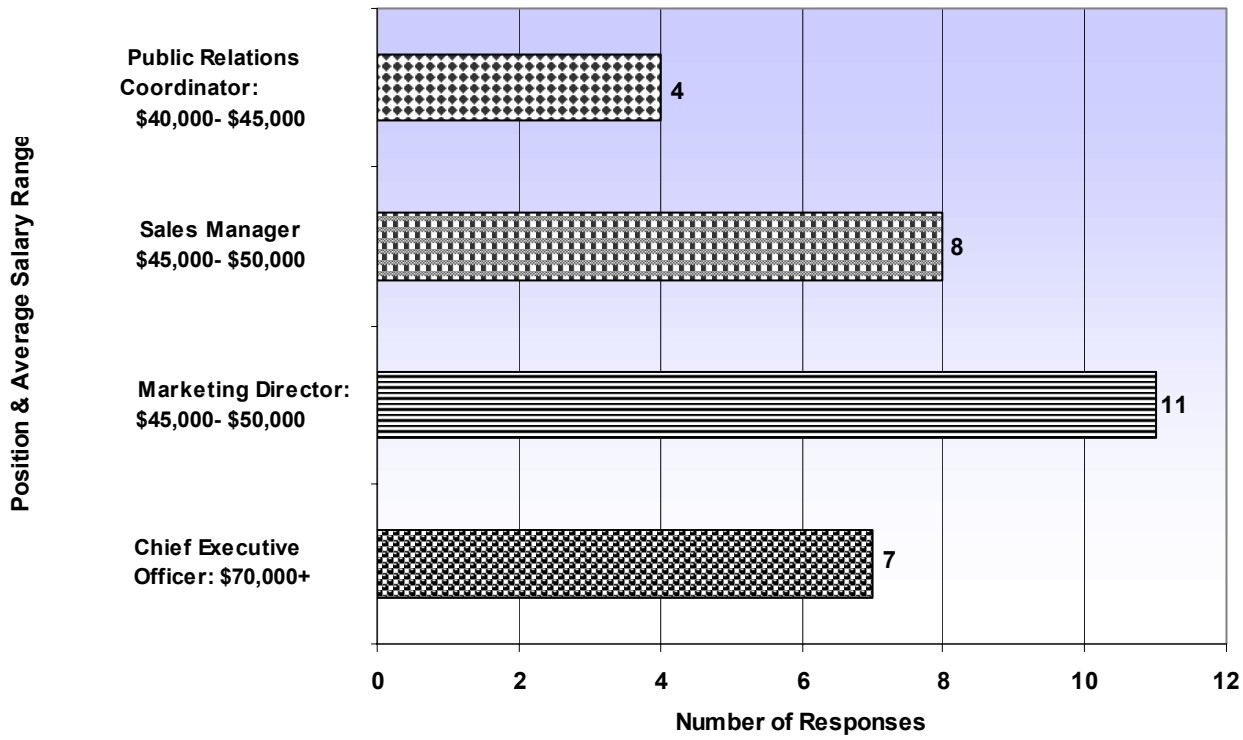

Figure 3: Suggested Washington Wine Business Positions and Salaries for University Graduates, 2005

Suggested job training for university graduates employed in the Washington wine industry.

The second portion of the survey included job training questions relevant to new university graduates from a viticulture and enology program. Of the 39 question respondents, 90% percent expected completion of a hands-on field internship experience prior to full-time employment in the wine industry. In regard to the number of internships expected, 80% of the respondents expected one or two internships while 20% expected more than two internships (Figure 4). Previous job-related internships and "hands-on" experience were found to be crucial to the success of university graduates in the wine industry. The majority of respondents found two internships to be sufficient for full-time employment and past "hands-on" experience was found to be in the top three desired qualitative skills in enology and viticulture sectors.

Conversely, such prior experience was not found to be as important for graduates entering the business sector as the skill was rated only slightly higher than the last category of "general farming knowledge". Over two thirds of respondents also indicated that they would expect to provide moderate to extensive training ranging from over two weeks to more than a month of guidance to university graduates hired in any industry positions.

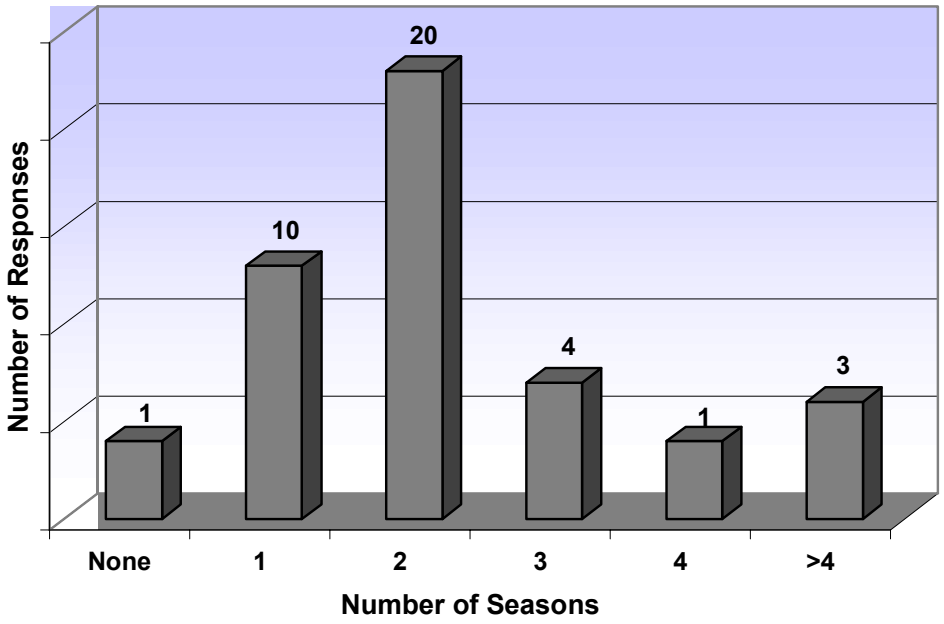

Figure 4: Number of Internships Expected Prior to Full-time Employment in Washington Wine Industry, 2005

In addition, 90% of the participants indicated that they would provide on-the-job training for new university graduate hires (Figure 5). Of the types of training provided, 39% indicated that extensive job supervision lasting more than one month would be expected while 34% determined that moderate training would be provided which would last less than one month but more than 2 weeks. Only 10% of those surveyed expected new employees to solely receive basic company protocol training without technical instruction. Expected position competence for

newly hired university graduates of a viticulture and enology program varied with 39% of respondents indicating that new hires should be able to complete most tasks and 38% believing they should be able to complete few if any tasks without supervision (Figure 6).

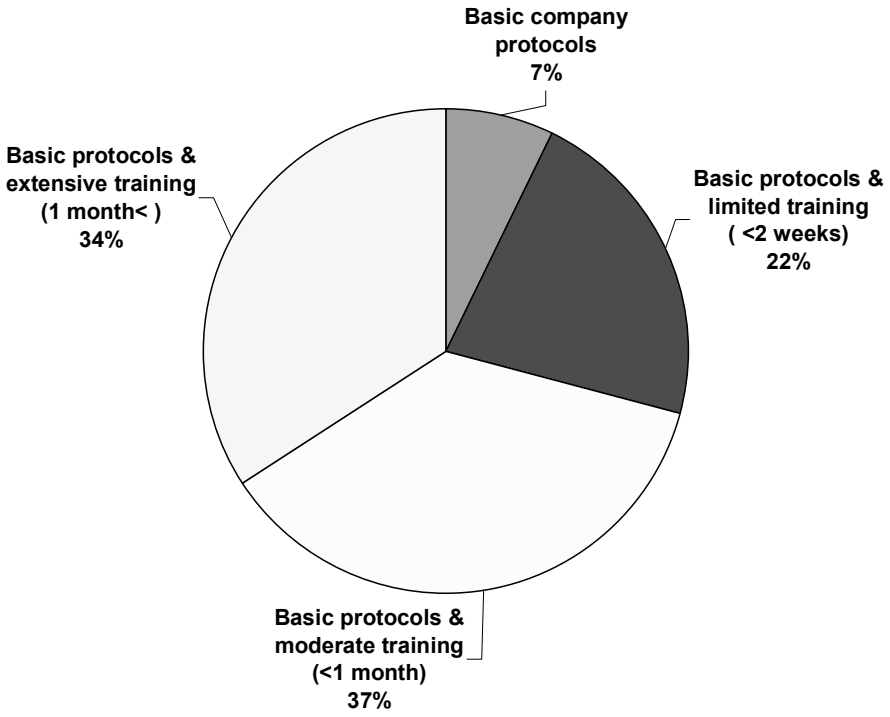

Figure 5: Extent of Position Training Provided to Newly Hired Graduates in the Washington Wine Industry, 2005

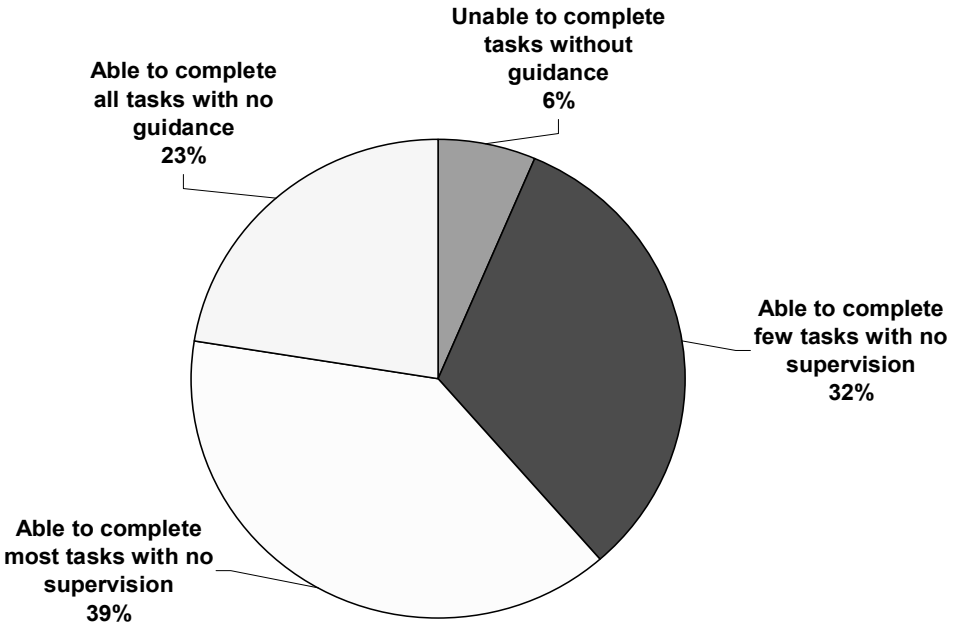

Figure 6: Expected Position Competence for University Graduates Employed in the Washington Wine Industry, 2005

Industry knowledge and skill expectations for university graduates entering the Washington wine industry. The last section of the survey addressed the essential knowledge and qualitative skill areas for university graduates entering the wine industry. Divided once again into the three different sectors of the wine industry, thirteen knowledge area options were provided for each segment and participants chose the five that they deemed most critical knowledge areas in that sector. In the viticulture section, the three highest ranking areas were general viticulture, irrigation and pest management, each with approximately 30 respondents (Figure 7).

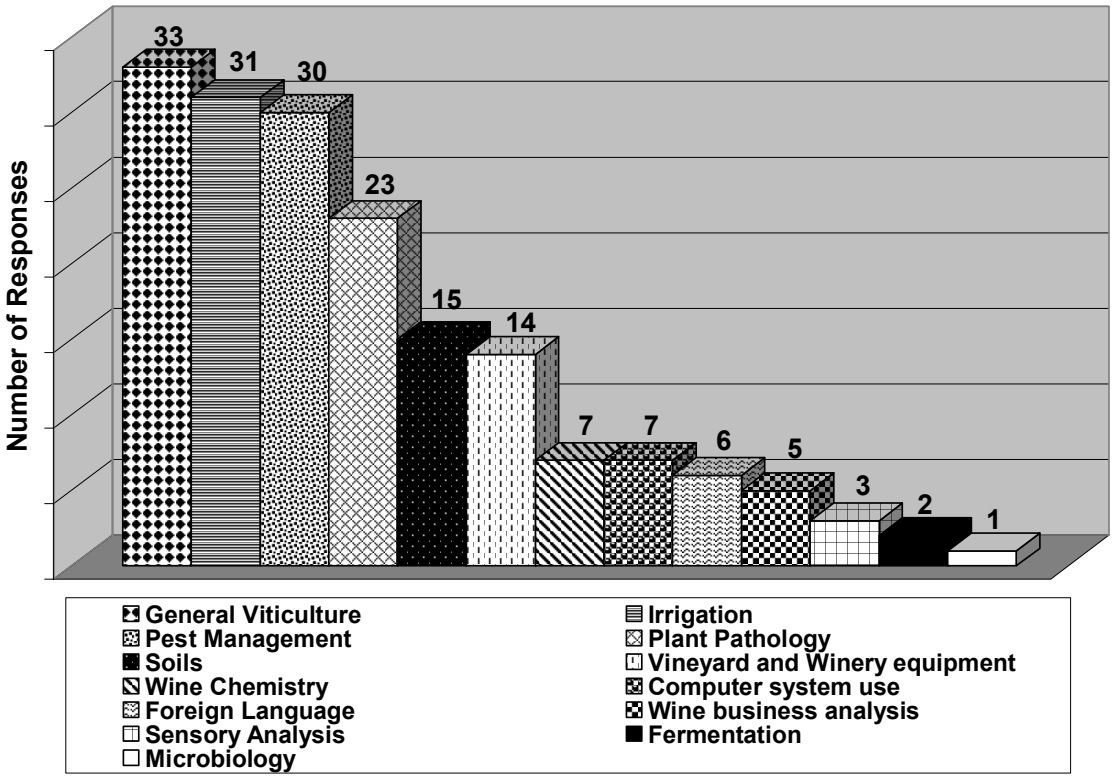

Figure 7: Viticulture Knowledge Areas for University Graduates Employed in the Washington Wine Industry, 2005

Plant pathology, soils and vineyard and winery equipment were also rated important with rankings from 23 to 14 respectively. Conversely the three most essential enology knowledge areas included wine chemistry and fermentation followed by sensory analysis. The next most important subject areas were microbiology, vineyard and winery equipment and general viticulture topics (Figure 8).

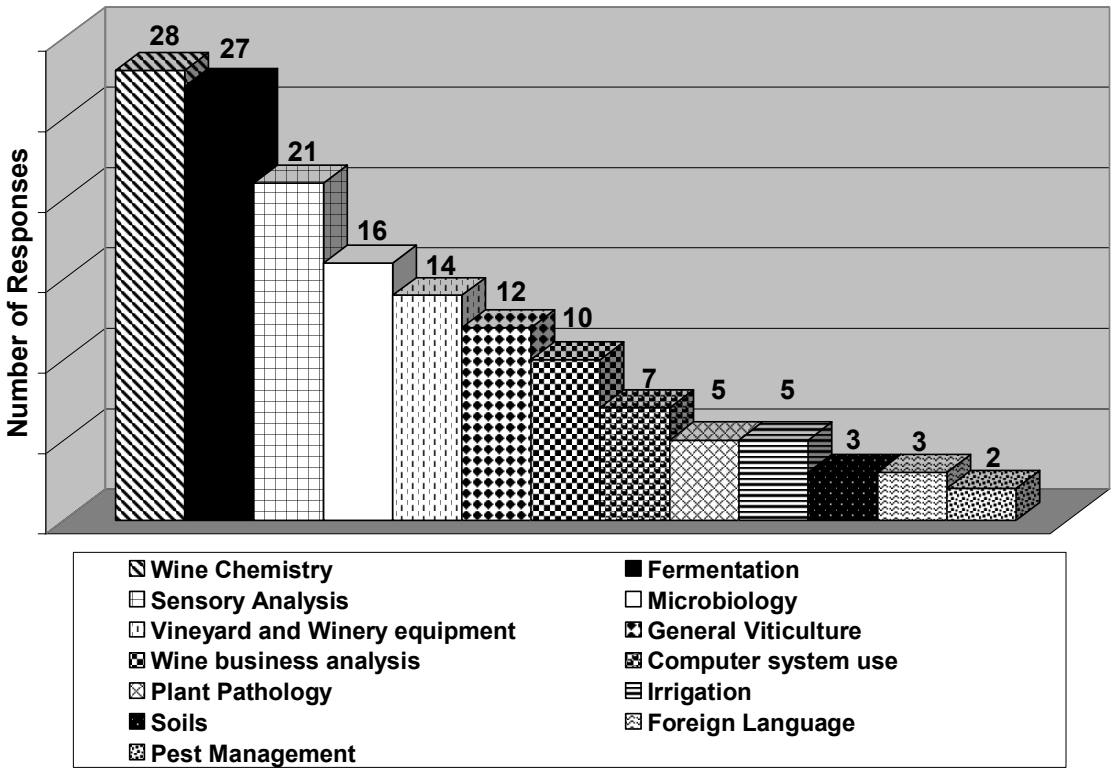

Figure 8: Enology Knowledge Areas for University Graduates employed in the Washington Wine Industry, 2005

Respondents clearly indicated that they found one major topic to be the most important in the business sector: marketing. Accounting, wine business analysis, communication and business law and tax codes were equally important but distant followers to marketing (Figure 9).

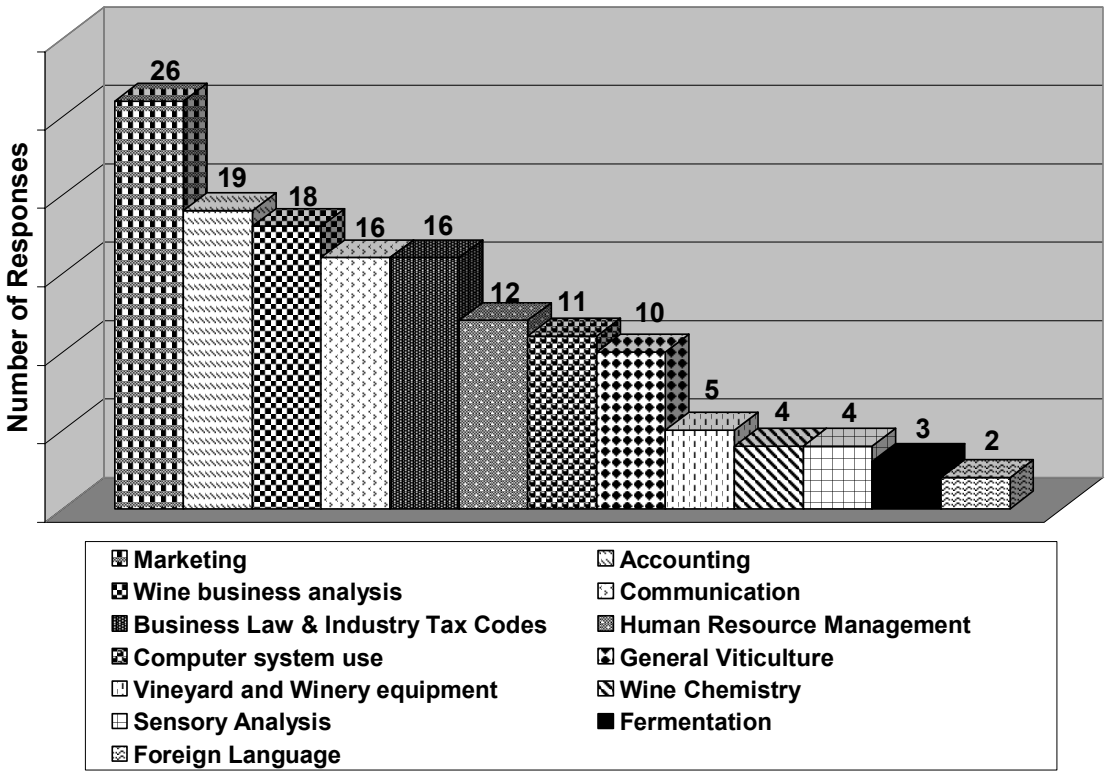

Figure 9: Business Knowledge Areas for University Graduates Employed in the Washington Wine Industry, 2005

Qualitative skills such as communication and leadership were listed such that eight distinct skill options were provided for each sector. Respondents were directed to choose the three most important for each industry sector. In viticulture, communication and past "hands on" experience in the position were very closely ranked as the top skills. Problem-solving skills and general farming knowledge were closely rated as the third most important skill (Figure 10).

Enology qualitative skills differed slightly with a well-developed palate identified as the most important skill while problem solving skills and past "hands-on" experience in position skills followed closely. Communication was listed as a distant fourth (Figure 11).

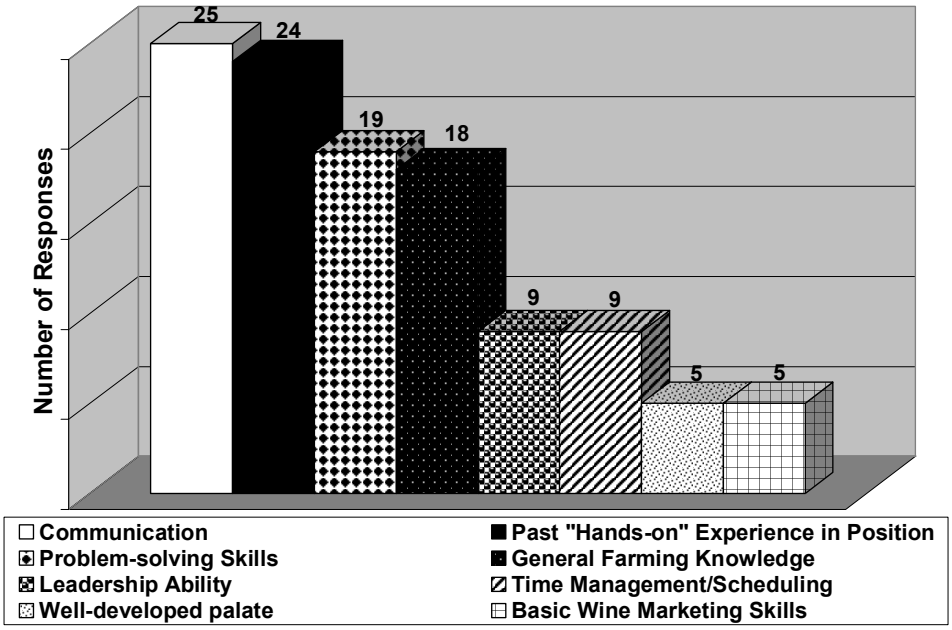

Figure 10: Qualitative Viticulture Skills for University Graduates Employed in the Washington Wine Industry, 2005

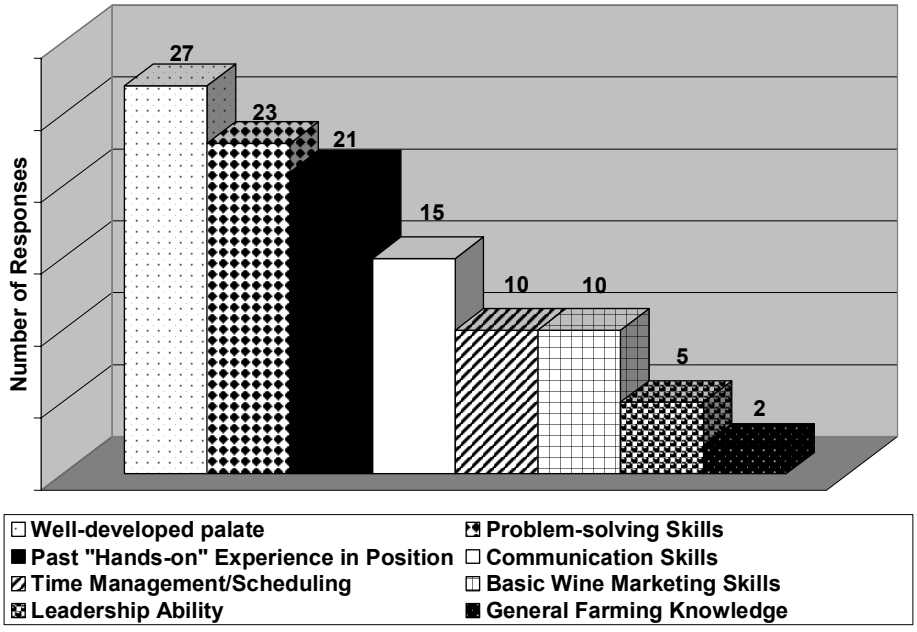

Figure 11: Qualitative Enology Skills for University Graduates Employed in the Washington wine industry, 2005

The qualitative skills found to be key in the business segment were similar to the enology segment in that one category was rated much more highly than the rest. Communication received more than 25 responses followed by basic wine marketing skills, and problem solving skill for the second and third key skills (Figure 12).

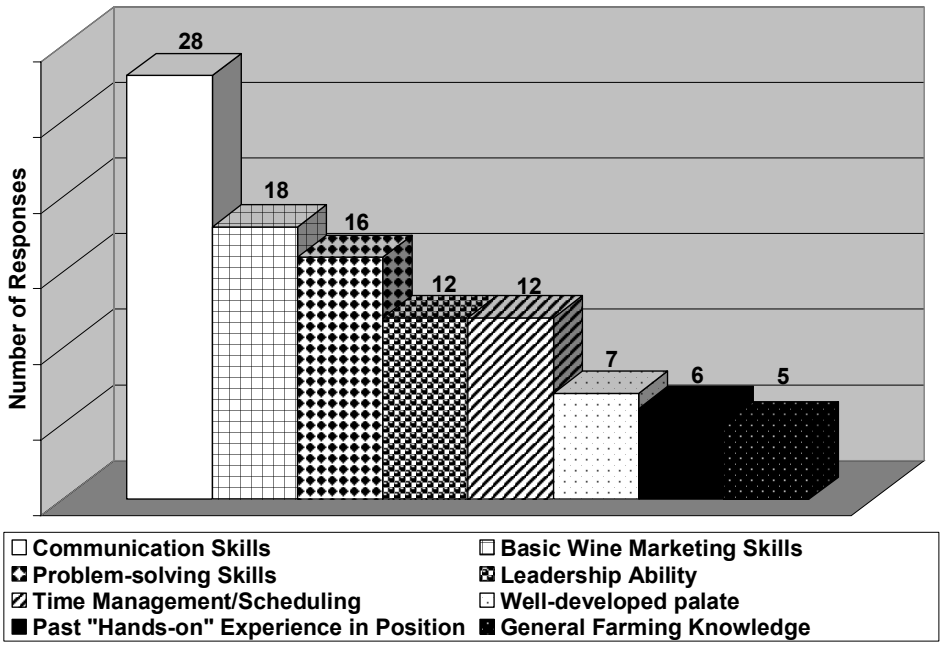

Figure 12: Qualitative Business Skills for University Graduates Employed in the Washington Wine Industry, 2005

DISCUSSION

The goals of this Washington wine education survey were very specific in that they were meant to build upon, rather than replace the past results of the study conducted by Folwell and Cembali in 2001. Wherein the first survey estimated the required education level for wine industry positions as well as the anticipated number of employees needed from 2001 to 2006, the current survey focused upon the expected climate upon matriculation for baccalaureate graduates entering the wine industry. Data gained focused on three major areas: 1) types of positions and associated salaries for university graduates, 2) job training required for success in these positions and 3) essential knowledge and qualitative skill sets in the various sectors of the wine industry.

In contrast to the previous mail-in survey, the current questionnaire was only available online enabling quicker response collection and more accurate tabulation of data as all results were seamlessly sent to a predestined Excel file, thus eliminating human error in data input. Another primary benefit of the current survey distribution methodology was the direct solicitation of potential candidates by project researchers at the 2005 Annual WAWGG convention. Such interactions helped to ensure increased validity in responses as survey instructions were verbally reinforced and respondent questions could be resolved easily. The gathering of demographic data from the respondents also helped to ensure the qualification of respondents based upon their degree of employment in the wine industry.

Due to lack of wine industry survey data available, the validity of the demographic information collected in regard to vineyard or winery size can only be generally compared to other more exhaustive studies with varied parameters conducted by the government (USDA 2007). Although annual wine and juice grape vineyard acreage is calculated yearly via the United States Department of Agriculture, the most recent estimation of individual vineyard size

in Washington State was determined by the 2002 United States Agricultural Census (USDA 2007). Despite the combination of both wine and juice grape vineyards in the survey, both the current wine industry survey and the 2002 census data revealed that the majority of vineyards are less than one hundred acres in size (Tables 1 and 3). The current survey did have a bias toward large vineyards operations such that only 67% of survey respondents were involved in companies holding 50 acres or less compared to the U.S. Agricultural Census determination that overall 76% percent of vineyards in Washington state held less than fifty acres. This result was contrary to the researchers' expectations. It was predicted that the oversight of researchers in denoting a "zero" category for the vineyard acreage demographic question (Appendix A), would cause some respondents to choose the "zero to twenty five acre" category even if they did not have any vineyard acreage. This would yield a larger than actual percentage of operations to be in the zero to twenty five acre category. Another theory for large number of small vineyard endeavors as found by the Census survey is that since the survey combined wine and juice grape acreage, a large number of small juice grape operations may be responsible for skewing the combined wine and grape vineyard sizes toward a smaller size. However, the likelihood of this option is low as contrary to the economics of premium wine grape production in Washington State, profitable juice grape production is highly dependent upon production size and marketable tonnage rather than perceived quality. Averages of 9 metric tons per 0.4 hectacre are expected for juice grape production as opposed to 3.6 metric tons per 0.4 hectacre in wine grape production (Ball et al. 2004, Ball and Folwell 2003). Due to the large amount of mechanization and associated high fixed costs with the high tonnages of juice grape production, small juice operations may be less profitable endeavors and thus, less common.

Another, more feasible option for the discrepancy between the U.S. Agricultural Census and current survey was that the larger wine grape vineyard operations were more active in the Washington Association of Wine Grape Growers meeting where the majority of the respondents were sampled. In fact, two-thirds of the board of directors at this time were involved in operations exceeding 400 acres (WAWGG 2007).

Table 3. Washington State Wine and Juice Grape Vineyard Sizes*

Vineyard Size (Acres)	**# of Farms**	**% Farms**	**Acres**	**% Acres**
0-49	916	76.4	10161	16.2
50-99	128	10.7	8924	14.3
100- 249	117	9.8	17940	28.7
250- 499	25	2.1	8808	14.1
Greater than 499	13	1.1	16683	26.7
Sum	1199	1	62516	100%

** As taken from the 2002 U.S. Agricultural Census (USDA 2007)*

Sample skewing issues were not as apparent with the winery size demographic information collected by the current survey. It must be noted that as in the vineyard demographic information section, a similar "not applicable" selection for case production was unintentionally absent from the survey such that skewing of the data toward small wineries with production of less than 5,000 cases may be possible, but the extent of which cannot be determined. Furthermore, the U.S. Census utilizes the parameter of number of employees hired rather than case production as was employed in the current survey to determine winery size. Moreover, the data collected by the Census is inclusive of ALL wineries in the nation rather than Washington alone. Despite these differences, a winery producing less than 5,000 cases annually may typically need up to ten or so employees to handle the winemaking, sales, marketing and general management practices. This enables comparison of the current Washington wine survey and the U.S. Census winery report possible. In fact, the much larger scale of the California wine

industry in overall production as well as winery size in comparison to second place producer Washington state may help mitigate these survey distinctions. In 2005, over 2,275 wineries were bonded in California and produced approximately 648 million gallons of wine (WI 1 2006, WI 2 2006) compared to the approximately 460 wineries in Washington which produced 18 million gallons (WWC 2006). Taken one step further, if every winery produced the same amount of wine, wineries in California would produce an average of 285,000 gallons per winery while those in Washington would only produce 39,000 gallons each. Such discrepancies in wine production may help to validate the current survey's determination of approximately 68% response rate in respondents involved in wineries less than 5,000 cases (Table 1) compared to the national norm of approximately 68% of wineries employing less than ten employees annually (Table 4).

Table 4. National Winery Sizes in Number of Employees*

Winery Size (in number of employees)	**N**	**Percent**
Establishments with 1 to 4 employees	707	59
Establishments with 5 to 9 employees	105	9
Establishments with 10 to 19 employees	141	12
Establishments with 20 to 49 employees	144	12
Establishments with 50 to 99 employees	49	4
Establishments with 100 to 249 employees	32	3
Establishments with 250+ employees	13	1
Total Respondents	**1191**	**100%**

**As taken from 2002 U.S Agricultural Census (USDA 2007)*

A minor flaw in the previous survey was that all wine industry positions were divided into either vineyard or winery work (Folwell and Cembali 2001). This division ignored a third and very important function of the wine industry: the business segment. While wine general managers, production managers as well as vineyard managers were all included in this survey, no additional upper management business related employees were included such as chief financial

officers (CFO), marketing directors, and sales managers. While this may be due to the fact that many Washington wineries were, and continue to be, small operations, such positions were present at the time and their numbers are growing due to the success of large corporations such as Constellation Brands and Ste. Michelle Wine Estates. The current survey found that a substantial number of individuals were identified as holding mid to high-level business positions and rated four of the highest ranking business management positions as being positions preferentially available to university graduates.

Average salaries for the three wine industry sectors also varied greatly. Viticulture positions were found to be the lowest overall while enology salaries were slightly higher. These results indicated that while the industry did prefer to hire university graduates for all positions listed, many of these positions did not provide a sustainable salary for university graduates over the long term. Reported annual initial salary averages for college graduates ranged from approximately $30,000 to $40,000 (WSJ 2007) which may indicate that employers paying less than this amount may be undervaluing these positions. A 2005 survey conducted by the National Association of Colleges & Employers' average starting salaries for graduates with bachelor's degrees in plant science were $31,226 while other agricultural sciences were $33,850 (WSU Sustainable Agriculture 2007). In viticulture positions such as crew supervision and associate viticulturist as well as enology positions such as laboratory technicians, applicants holding a bachelors degree would be preferentially hired but salaries of these positions are not competitive with the starting wage for baccalaureate degree holders in other industries as they are under the $30,000 annual salary threshold. Thus, while these positions may provide adequate compensation for first year baccalaureate graduates, after such time, average salary comparisons indicated that it may be more realistic to hire community college graduates in these positions.

Irrigation managers, viticulturists and assistant winemakers are feasible initial positions for university graduates as salary scales for all these positions are in the mid-$30,000. However, such positions may not be realistic for university graduates past five or more years. After this time, advancement and increased salaries expectations may cause employees to seek advancement at higher paying operations. However, the marketing perception propelled by some wine industry groups may help to counter these low salaries at least initially (Stone et al. 2005).

The most feasible long-term positions for university graduates include all the business positions listed, production managers, lead winemakers, and vice presidents of production in the enology sector as well as some vineyard manager positions. Given that the salaries of these positions were also found to be the overall highest among the individual wine industry sectors, such jobs may be more attractive to university graduates who expect higher salaries due to educational training (Coombs 2006, WSJ 2007). The determination that business salaries are relatively higher than their other wine industry sector counterparts' results echoed those of the recent survey conducted in 2005 for Wine Business Monthly (WBM) magazine detailing the average salaries of winery employees in California based upon winery case production. Even at the smallest production scale of less than 50,000 cases, a chief executive officer (CEO) was expected to earn a mean salary of $172,000 compared to a winemaker of the same production size earning $95,000 and a vineyard manager earning a mean of $72,000 (Lindroos 2005).

Lower salaries may also be more indicative of the Washington wine industry than the larger California wine industry. Overall, average salaries for winery mid to high-level employees in the WBM magazine were much higher than those found in the current Washington wine education survey. The annual mean salary of a winemaker employed by the smallest winery production designation of manufacturing less than 50,000 9-liter cases annually was

approximately $95,000 (Lindroos 2005) while a mean salary of $52,500 was determined by respondents in the current survey for a winemaking position at a winery in Washington. Similarly, a vineyard manager at a similar sized winery in California was found to earn a mean of $72,000(Lindroos 2005) compared to a mean salary of approximately $40,000 in the Washington state industry. This salary disparity trend was consistent throughout enology and business factions and is corroborated by a the same WBM survey wherein two founders of distinct executive placement firms indicated that while salaries are relatively consistent across California, they are lower in Oregon and Washington. These data did not include top-level business salaries which are relatively comparable to similar positions in California (Lindroos 2005).

Despite the similarities in subject matter, several confounding variables make comparison of the WBM survey with the current Washington wine education survey difficult. In the WBM survey, only wineries were surveyed thus eliminating any sole vineyard grower operations and the only viticulture position surveyed was that of a vineyard manager. In contrast, the current survey was advertised at a conference organized by a wine grape grower organization and attended by all industry sectors as demonstrated by the demographic data of respondents provided. In addition, those wineries that responded to the WBM survey were qualified via annual production size wherein small wineries were deemed as producing less than 50,000 cases, medium wineries 50,000 to 99,999 cases, large wineries from 100,000 to 499,999 cases and extra-large wineries producing 500,000 cases annually or greater. In the current Washington industry survey, the largest category available was for wineries producing greater than 40,000 cases annually. While only a quarter of wineries surveyed produced less than 50,000 cases, over one third produced more than 500,000 cases indicating that the WBM survey was

much more applicable to larger operations. The large 2005 annual production distinction between Washington and California aforementioned also corroborated this theory. Unfortunately, no other research has been conducted concerning salaries in Washington State wineries to determine if such salaries were indicative of the industry norm or complicated by other variables.

This study confirmed the industry demand for previous job-related internships required by the current Washington State viticulture and enology program. While the majority of respondents found two internships to be sufficient for fulltime employment and past "hands-on" experience was found to be in the top three desired qualitative skills in enology and viticulture sectors, such prior experience was not found to be crucial for graduates entering the business sector as the skill was rated only slightly higher than the last category of "general farming knowledge". Possible explanations for this variation include the site-specific nature of viticultural and enological techniques, a view of business topics as more related to "theoretical" bases than experience-oriented, or even a general lack of knowledge of primary business practices by respondents.

While graduate competency results echoed the desire for students to have prior internship experience in the field, the vast majority of survey respondents readily admitted to holding an expectation to provide moderate to extensive training ranging from over two weeks to more than a month to university graduates hired in positions. Furthermore, additional survey results indicated that less than one-quarter of those surveyed expected graduates to complete all needed tasks with no guidance. Both of these major results confirmed the supposition that while prior experience and internships are important to graduate success, employers in Washington State's wine industry do not currently expect university graduates to perform immediately without

assistance. The self-declared expectation of industry respondents to provide strong training matched with very reasonable competence expectations ensured that employers realize that university graduates, regardless of classroom instruction, require a period of adjustment to positions in to which they are newly hired.

In the 2001 Folwell and Cembali survey, problems with overlapping of skill competencies were noted in winery positions such as general manager and production manager, as well as full and part time and vineyard pruning and harvesting crews. Results of this current survey indicated that this intersection of skills may have been due to lack of position knowledge by the researchers. Although general managers and production managers do exist at some wineries, these positions are typically only found at large entities. A secondary reason why many of the skill competency ratings overlapped in the first survey may have been due to the number of skill categories rated. Five main categories were included in both vineyard and winery surveys such that 18 and 23 subcategories were rated respectively. Therefore, it may have been difficult for respondents to distinguish between positions as the length of the survey may have precluded well-constructed responses. Furthermore, qualifying questions regarding the size of the vineyard or winery and the position of the respondent were not included. Again, this challenges the effectiveness of such a request as the perception of the individual completing the evaluation is exclusively tied to their personal experience in the wine industry which may differ greatly given the large size variability of companies as well as their role in the industry.

The current survey grouped all positions in a sector together when determining desired skills and knowledge sets for university graduates thus enabling differences between skill sets to be illuminated based upon broader categories. As a result, divergence between the skills and knowledge sets of viticulture, enology and business sectors of the industry emerged. The highest

rated knowledge areas for university graduates were those most specifically related to their sector of the industry. Graduates specializing in viticulture were expected to be proficient in skills directly related to vineyard field work; general viticulture, irrigation, pest management, plant pathology, soils and vineyard and winery equipment. Conversely, graduates seeking to enter the enology sector of the industry should be well versed in wine chemistry, fermentation, sensory analysis, microbiology, vineyard and winery equipment and general viticulture. Suggested curriculum revisions in other intensive scientific disciplines such as analytical chemistry and environmental science have also touted the importance of industry-specific courses as essential to building student knowledge base for their future careers (Barker and Graveel 2004, Mabrouk 1998). In addition, those in the business sector were suggested to have an adequate depth of working knowledge in marketing, accounting, wine business analysis, communication, business law and human resources. Therefore, for graduate success in the wine industry, focused instruction as well as primary preparation in these areas must be regarded as the key to student success.

Qualitative skill sets desired of university graduates entering the wine industry varied for the business sector. However, two primary skills were found to be in the top four skills regardless of industry segment: communication and problem-solving. Unlike the knowledge areas listed above, these skills were not industry sector specific and can be developed regardless of course content. Similar results have been reported in other industries such as information technology, environmental science and general business wherein curricula revisions based upon industry surveys have indicted the need for graduates with well-honed communication skills, learning ability, advanced problem-solving skills as well as professional competence (Barker and Graveel 2004, Dudley et al. 1995, Petrova and Claxton 2005). Thus, the focus of courses should

reach beyond expanding student knowledge such that problem solving, critical thinking and communication capabilities are emphasized equally.

While this survey succeeded in enumerating the general salaries, knowledge, skill sets, previous internship expectations and job training desired of baccalaureate degree graduates by a subset of Washington wine industry members, a few important aspects should be considered to increase the relevance of future research in this area. First, while the use of an online survey was beneficial to data collection and response rates, future surveys should be more concise and tailored to permit instant user response modifications of the questionnaire. In this way, questions related to industry sectors with which respondents may have been relatively unfamiliar could be automatically bypass based upon their previous answers. Not only could this decrease subject fatigue and increase overall response rate due to lower time demands, more valid results may have been generated as subjects would be unable to give responses to questions to which they may not be well associated. Secondly, a more exhaustive selection of wine industry positions for respondent demographic information as well as potential graduate salary selection may increase the accuracy of position enumeration, particularly in larger companies. Unlike their smaller winery counterparts, larger organizations tend to have more discrete position descriptions and less overlapping of job responsibilities. However, at this point in time, many more small wineries exist than larger ones in Washington State, thus requiring the ability of respondents to choose more than one position description to describe their current employment situation. Finally, in order to increase data applicability in future wine industry survey research a "not-applicable" denotation is needed for vineyard and winery acreage demographic questions (Appendix A). The absence of this option prohibited the intended use of inferential statistics to correlate the demographic information collected with response subsets.

The last twenty years revealed a rapid growth in the Washington wine industry as well as a need for educated university graduates to fill prospective positions in this arena. However, despite a needs assessment as to the skills and positions needed prior to development of a university program, a supplemental survey had not been completed to address the job outlook and industry expectations for university graduates entering the wine industry. This survey provided valuable information about the current employment status of the Washington wine industry for baccalaureate graduates and enables future research to be conducted.

CHAPTER 2: THE VIRTUAL VINEYARD

INTRODUCTION

Background of the Washington State University Viticulture and Enology program. As a land grant university established in 1890, Washington State University's mission to "enhance the intellectual, creative and practical abilities of the individuals and communities that we serve by fostering learning, inquiry, and engagement" (WSU Strategic Plan 2006) has been of the utmost interest to its constituents. At the inception of the Washington State University Viticulture and Enology program, the Washington state wine grape production and processing industry was expanding at unprecedented levels, resulting in significant demand for 4-year college graduates educated in Washington. Thus in 2001, the university developed a viticulture and enology baccalaureate degree to meet the educational and employment needs resulting from the increase in wine grape production. A consortium composed of representatives from Washington State University along with Yakima Valley, Walla Walla, Wenatchee and Columbia Basin Community Colleges held several meetings to discuss the development of a comprehensive viticulture and enology curricula for associated and baccalaureate degree programs. Based on the results of the education consortium meetings, the completed needs assessment survey of the wine industry, as well as advisement by a board of directors which included appointees from academia, industry and the WSU administration, a framework for the degree was developed.

Given the industry's desire to have the program available to current place-bound employees in the wine industry, it was determined that courses would be offered via video telecommunications from the main Pullman campus to the Tri-Cities satellite campus. General education requirements such as math, English and social science courses were included to ensure well-rounded graduates. Furthermore, important mid-level foundational science courses in

chemistry, entomology, soils, plant physiology and horticulture. Internship requirements were added to ensure that graduates were able to excel in intellectual as well as practical competency.

In addition to these pre-existing courses, three new senior and graduate-level wine specific courses were added: advanced viticulture, wine chemistry, and wine microbiology. Although taught by different instructors with varied teaching styles, the basic formats of the courses were the same such that a traditional lecture format was adopted. In the wine microbiology and wine chemistry courses two mid-terms exams, one special topic paper and a final exam were utilized as gauges for student involvement and assessment while the advanced viticulture course utilized a similar structure with two mid term exams and a final project.

To ensure that the knowledge and skills necessary for success in the industry were being addressed by the WSU program, the first portion of this project encompassed a cooperative industry survey was conducted in the spring of 2005 to assess training, knowledge and university graduate skill expectations of employers in the Washington State wine industry. Divided into viticulture, enology and business industry segments, key areas of emphasis were determined. As indicated in chapter one, results of the survey indicated that the five most important viticulture knowledge areas included general viticulture, irrigation, pest management, plant pathology and soils. Essential qualitative skills determined by industry members included communication, past "hands-on" position experience, problem-solving skills, general farming knowledge and leadership ability. Moreover, communication and problem-solving skills were the only two qualitative skills found to be rated in the top three most important skills regardless of industry segment.

Teaching methodologies to enhance learning outcomes. While the traditional lecture format of a classroom may be appealing in some instances, recent research indicates that it may not always be the most effective in developing some of the key requirements in education such as long term knowledge retention, higher-order critical thinking and problem-solving skills, communication and teamwork (Amador and Gorres 2004, Ahern-Rindell 1999). Instructors report students in traditional lecture formats have difficulty in knowledge retention, material integration and application of acquired knowledge to new situations is poor (Amador and Gorres 2004). Furthermore, research indicates that the essential skills of communication and problem-solving are not actively honed by students enrolled in such passive-learning courses (Butler 1999).

In response to pitfalls identified in lecture instruction, in disciplines that require complex problem-solving skills, high-level knowledge integration and well-developed communication and teamwork skills such as medicine and law, a more student-centered approach known as "problem based learning" or "PBL" has been instituted. In a 2003 survey of United States medical schools accredited by a teaching assessment committee known as the "123 Liason Committee on Medical Education", 70% of them were using at least some form of PBL in their preclinical education (Kinkade, 2005). Invented and instituted by McMaster University Medical School in Hamilton, Ontario Canada over thirty years ago, in its most pure form this methodology of teaching eliminates lecture instruction completely. Conversely, it involves students working with a faculty "tutor" during their class time wherein they solve realistic cases (Herrid 2003). This tutor is responsible for keeping students on task, guiding groups toward the essential issues in each case, presenting additional case data and assisting groups as needed (Ibid).

The purported benefits of a problem-based approach to enhance learning are based upon the belief that this method is effective for the following reasons:

1. Enhanced problem-solving and higher-order reasoning skill development (Barrows 1986, Abrant Dahlgren and Oberg 2001)
2. Increased motivation and self-directed learning in and beyond course material (Norman and Schmidt 1992, Sinatra and Pintrich 2003)
3. Better retention and holistic application of knowledge in "real-world" settings (Schmidt, 1983, Saarinen-Rahiika and Binkley 1998)
4. Elevated communication and discussion skills (Saarinen-Rahiika and Binkley 1998)
5. More developed teamwork and cooperative learning skills (Mamede et al. 2006)
6. Amplified student and instructor enjoyment of the teaching and learning continuum (Harlow et al. 2006, Butler 1999)
7. Curriculum is necessarily current and inherently research-based (Vernon and Blake 1993).

Despite these five major benefits, two documented drawbacks to the use of PBL in curriculum include:

1. Increased faculty financial and time expenditure (Albanese and Mitchell 1993)
2. Decreased knowledge of course-based content materials (Hemker 1998)

Rather than simply being given the information, students are required to discover and employ outside resources to solve their cases (Mamede et al. 2006). Proponents of PBL as a teaching and learning strategy point out that adult learning techniques such as critical thinking is

increased as students must apply, integrate and build upon current knowledge to solve PBL cases (Riseman et al. 2005, Smith 2001). In addition, some researchers report increases in student interest, involvement, and knowledge persistence due to the industry relevance, emotional climate, and personal communication involved in problem based learning (Beers and Bowden 2005, Beers 2005, Dollman 2003, Udovic 2002).

Despite more resource expense and a stronger time commitment on the part of the teachers as well as students, both sides typically rate PBL favorably and significantly higher than traditional learning formats (Berntein et al. 1995, Udovic 2002, Smith and Masberg 2001, Amador and Gorres 2004). Yet controversy as to the effectiveness of PBL in knowledge acquisition still exists such that the majority of PBL curricula are significantly modified to fit course and instructor goals. In the afore mentioned study of medical school education, of the 70% of schools which utilized some PBL teaching in preclinical education, 78% of these used it for less than 25% of formal teaching (Kinkade 2005). Three major categorizations of PBL usage in courses as described in the literature include single course implementation, transitional curricula and complete curricula integration (Saarinen-Rahiika and Binkley 1998). Complete curriculum integration involves PBL implementation into all curricula courses which while capitalizing on the benefits of PBL, is associated with high student stress levels initially in the curricula due to unfamiliarity of most students with the PBL process (Saarinen-Rahiika and Binkley 1998). Furthermore, in completely integrated curricula, some opponents have suggested that PBL makes it difficult for students to identify and bond with good teachers, inhibits teacher knowledge sharing with students and does not encourage long-term organization of the knowledge acquired (Hemker 1998). Conversely, transitional curricula permits gradual conversion of student learning from a traditional format to one of PBL gradually via increased

content-integration, small-group work and student-centered learning as students matriculate from lower to higher level courses. Finally, single course curricula can be a good option , as it is the most easily adopted and permits pairing of the benefits of traditional lecture techniques like instructor resource conservation along with the advantages of PBL learning. However, this hybrid can be difficult as the student skills required may be unfamiliar to traditionally educated students and the integration of curricula and context learning across courses is compromised (Saarinen-Rahiika and Binkley 1998).

Some consider modifications of PBL wherein it is not completely integrated into the curricula as simply a derivation of cooperative case-based learning as they do not replace all of traditional teaching with case-based learning. However, others believe that as long as students are given case-type problems in small groups which require some sort of completion outside of class time, this fulfills the basis of problem-based learning (Herreid 2003, Kinkade 2005). Given the broad spectrum of PBL definitions and implementations, for the purpose of this study, problem-based learning will be considered the latter.

Problem based learning enhancement in the Viticulture curriculum. While PBL use in medical and law education is well documented, research and associated case application in agricultural disciplines is scattered and disjointed (Jolliffe et al. 2005). Agriculture, similar to medicine and law, may be especially suited to PBL as the case solving emphasis can help students learn, retain and apply agricultural concepts that they learn inside the classroom as well as strategies to solve future problems (Rudd 2005). While pedagogical transformations in curricula may be difficult for both students and professors and large classes may not be ideal for PBL as active participation among all students and timely feedback from professors is difficult, this teaching methodology has proven successful for many other courses (Riseman et al. 2005).

Amador and Gorres published an article in 2004 detailing the use of PBL to teach introductory soil science wherein students and professors found PBL to be a successful approach to teaching. Seventy percent of the students found PBL to be effective for learning and 61% preferred the PBL style to traditional methodology at the end of the course (Amador and Gorres 2004). In 2005 Jolliffe et al. reported PBL to be successful for teaching horticulture provided that it is practiced and assessed in an organized and well-planned fashion. Without consistently well written cases and skilled tutors, some of the initial attempts of the researchers were ineffective. Despite initial difficulties in PBL implementation due to these factors, at the final course evaluation 85% of students indicated that they would rather take a PBL course than a solely lecture course (Jolliffe et al. 2005). External reviews of their horticulture program revealed that students not only held an adequate knowledge base, but were also able to express their understanding of important concepts (Jolliffe et al. 2005).

Given the benefits of PBL in upper-division coursework and its effectiveness in the limited agricultural courses in which it has been utilized , implementation of PBL into current curricula in the advanced viticulture course was a logical and necessary objective. Based upon the results of the initial industry survey which indicated that problem-solving and communication are integral skills for viticulture and enology students paired with the desire of instructors to cover more material between lecture and course application, a modified PBL curriculum was suggested and implemented. The goals of the curricula modification of the Advanced Viticulture course at Washington State University were as follows:

1. Increase student competence in the top five areas deemed most important by Washington viticulture professionals as determined from the current project survey: general viticulture, irrigation, pest management, plant pathology and soils.

2. Foster development of essential qualitative skills determined by industry members: communication, past "hands-on" position experience, problem-solving skills, general farming knowledge and leadership ability.
3. Heighten student engagement, interest and confidence in viticulture related activities. Enhance "real-world" applicability of the course such that students develop the skills to effectively gather, analyze and apply information required in high-level critical thinking problems in and outside of the classroom.

RESEARCH DESIGN AND METHODS

Course structure. Based upon the findings of the industry survey conducted in 2005 (chapter one), curriculum for an Advanced Viticulture course was modified to address the primary knowledge and skill series indicated by trade respondents. As an upper division course, the material was geared towards 3rd and 4th year university students as well as graduate students which were required to attend additional bi-weekly seminars covering current viticulture research. In past years, course curriculum primarily focused upon general viticulture, soils and overall irrigation principles. Due to the vast amount of viticulture related material to be covered, sections on pest management and plant pathology were limited and expected to be covered via internship experience.

In the current project, the course was comprised of two co-instructors, one primary instructor, and a course tutor and curriculum was divided into three separate modules. In order to address the primary topics requested by industry professionals in the industry survey conducted in the Spring of 2005, each module was covered by one instructor. Lectures two times per week for a length of seventy five minutes were given and modules were taught based

on the primary viticulture knowledge skills outlined via the industry survey, logical course development and individual professor expertise. In the first module, site selection, climate, soils and primary irrigation considerations were addressed. The second module covered normal and abnormal grapevine anatomy and morphology and its relation to pest and pathogen issues. The last section detailed specific vine training and irrigation regimens as well as synthesis of the materials covered in prior modules.

Virtual Vineyard design. Fourteen students entered the Advanced Viticulture course at Washington State University in the spring semester of 2006. While similar to the previously employed teaching methodology, the primary difference between the traditional and modified course curriculum was related to the methodology of class participation and assessment. In contrast to the two exams and one final project completed by students in prior years, the modified course utilized a modified PBL teaching strategy. In this method, students are divided into groups and required to work together to provide a solution to a realistic industry problem or case.

In the modified PBL Advanced Viticulture curriculum, each group formed a fictitious vineyard consulting firm and was given a "base case" describing a realistic vineyard planting scenario. Each was located in a distinct site-specific growing region throughout the state of Washington (Appendix B). Given the expected discomfort among students to the modified PBL teaching methodology, students were divided into groups of 2-3 based on their own choosing rather than via instructor selection. This was done in an attempt to increase their comfort in group discussions and acceptance of the transition.

Coined the "Virtual Vineyard", each case described a client and an actual land parcel in Washington state upon which the fictitious client would like to plant wine grapes. To reinforce

the importance of site specific viticultural techniques upon wine grape planning, planting and productivity, land parcels were chosen such that each was distinct. Groups completed three distinct project modules which were built upon the base case by focusing on aspects of viticultural planning, planting and management. Although each individual project module coincided in conceptual content and date with each of the instruction modules, the project modules built on the information gained in the previous course module such that integration of the course material and activities were key to student achievement. In addition, a budget consistent with the background of the "client" was given and students were required to assess fees for activities related to vineyard planning, planting and management and present the financial statement in the final project module.

Virtual Vineyard base case development. One of the most integral parts of a successful problem-based learning curriculum is the creation and employment of well-designed case scenarios wherein the solution is inextricably linked to the context of the problem (Abrandt Dahlgren and Oberg 2001). Key aspects of a well-designed PBL case are its reasonable but not impossible complexity and structure, ability to engage and encourage self-directed student involvement and use of scientific concepts integral to the course content (Saarinen-Rahiika and Binkley 1998, Abrandt Dahlgren and Oberg 2001). The Virtual Vineyard cases were developed by the course tutor and primary course instructor with input from the co-instructors as well. Each case was unique in regard to the viticultural goals and financial means of client, site location and specific advantages and limitations, and general presentation. While student "consulting" groups were given a base case which had limited information as to the client and site available for planting, a confidential "outline" of the core concepts and issues expected to be

explored by the groups throughout the projects was developed to guide responses to group questions throughout the projects.

Companion Web Platform. An electronic course instruction platform known as "WebCT" was utilized throughout the course. A page for the "Virtual Vineyard" was located on the course WebCT site wherein project instructions, current events, useful research articles and links as well as evaluations were posted. Each group also had a private discussion forum wherein they could post communication to each other as well as submit site evaluation, testing, and client communication requests (see below). While instructions, guidance and questions were addressed in the classroom as well as via online contact, consultation groups were responsible for completing the projects outside of class time.

Project modules. In the first module, student groups received a randomly selected "base case" (Appendix B) and were required to present a proposal to their client indicating what types and quantities of wine grape varieties should be planted as well as why these determinations were made. Groups accomplished this task by utilizing the WebCT platform to submit requests to their tutor via a threaded discussion forum wherein comments and information were uploaded onto a site and remained there for the duration of the course. Students devised information pertinent to their case by submitting requests for information on their discussion forum in one of three categories: client communication, site evaluation or site testing. Those submitted for client communication were to contain questions related to the background, goals and personal needs of the client in regard to their vineyard planting. All requests were to be addressed to the client and completed in a business letter format to increase the realism of the submission. Site evaluation and site testing requests were to be written in a pre-designed format indicating the type of evaluation or test requested and the specific procedures that the consulting group would need to

take at the site to gain the needed information. The goal of this works was to challenge students to not only determine what type of information they would need from the site to complete an accurate planting report, but also to challenge them to determine how they would realistically obtain this site-specific information in the real world. The student tutor would then formulate the response acting as the client, laboratory or other case professional. For example, if the soil composition of the site was determined to be important, the student consultation group would need to submit a request of where and how a soil sample would be taken and then submit a request for what type of tests would need to be done on the sample to determine the composition. A response would be generated including a report of the soil test results as well as a bill for the procedures.

Requests submitted on either Tuesday or Thursday (the course days) would be completed by the course tutor and then the responses posted on the forum the next course period. In addition to client and site specific information that could be determined, students were required to utilize scholarly literature to support their ideas in all project modules. Specific guidelines were composed for each of the modules (Appendix C, Figures C1- C5).

In the second module, a computer simulation program known as "Diagnosis" was utilized to investigate the effects of pest and pathogen presence upon wine grape productivity. Due to the course layout of the in-class lectures, groups were "fast-forwarded" to their clients' prospective simulation to diagnose vine health problems in their clients' mature vineyard.

Designed for implementation into a horticultural curriculum by Terry Stewart at Massey University of New Zealand, this simulation program enabled the tutor to create an automated simulated case rather than generate each student-directed response individually (Massey 2007). Actual pictures, descriptions, test results and symptom identification from vineyard literature

were uploaded into the program such that each vine affliction provided realistic information. One major and two minor afflictions plagued each group's vineyard such that the cases were sufficiently complicated and avoided easy diagnosis. With each action costing a given amount of money, groups assessed the vines, ran simulated tests on chosen parts of the vine as needed and analyzed the given results of the tests to determine their significance. Students were also required to utilize additional resources to diagnose the problems. While a list of options such as vine physical appearance, testing, history, etc. was provided by the simulation as created by the tutor, students were required to "save" their casework to show what steps they took to determine the diagnoses as well as the cost of such work in regard to test processing and time for consultation.

The last module required students to determine the planting design, irrigation plan as well as the vine canopy management system to employ for their client's vineyard via a "time-warp" backward. In this way, the groups were required to integrate their previous variety selection recommendations from the first module with the results from the second module to determine the best canopy management strategies for their site to increase varietal productivity and quality while decreasing pest and disease pressure. In conjunction with course lectures students relied upon relevant reference materials such as journal articles, textbooks, direct industry contacts, and electronic resources for completion of all three modules.

Assessment. Divided into three project modules, students were assessed via individual project summary papers, course participation, and independent research study as well as peer, and self evaluations. The grading for the course were as follows:

GRADING:

Module 1 Project Summary	100
Module 2 Project Summary	100
Module 3 Project Summary	100
Oral presentation of independent research study	100
Participation in class & fieldtrips	50
Total	**450 points**

Project summaries. Following the completion of a module, each member of the consulting group was required to produce a written project summary paper of approximately five pages in length detailing their approach and solution to the project module. Emphasis for each paper was placed upon the ability of the student to demonstrate high-level problem-solving skills through the presentation of a clear, rational, realistic and integrated solution.

Although students work in groups, reports were completed individually to allow each participant to write their own conclusion as well as ensure improvement in individual student writing. Papers were due approximately one week after the completion of the module lectures. Students were given guidelines for each module paper detailing the key components and issues to be addressed in each (Appendix C, Figures C1-C5). In class lecture time was also used to orally explain the requirements and address student questions.

A defined grading rubric designed via compilation of industry goals as determined from the recent survey, content and process evaluation (Appendix D). Each project summary paper was worth one-hundred points and the grading was based upon the following: leadership and teamwork (15%); problem-solving skills (25%); practical competence (25%); quality of collated information (20%); and communication (15%). Rubric grading forms were completed by the section instructor and the primary instructor for the course. Scores as well as individual strengths and weaknesses in each category were noted on the form.

Independent research studies. In addition, students completed self-directed research studies concerning a viticultural topic of their choice (Appendix A) worth a maximum of 100 points. Following an oral presentation of the project and its results, students received feedback from the instructors as well as their classmates.

Course participation. Student attendance and activity in class discussions were an integral portion of the Virtual Vineyard. Fifty points of the cumulative four-hundred and fifty were designated as "participation" points. In conjunction with in class and field trip attendance and participation, "minute papers" assigned at random throughout the second portion of the course were utilized to emphasize key concepts in the lecture material and pertinent assigned readings.

Self and peer evaluations. At the conclusion of each module students completed performance evaluations of their efforts as well as the work of the other students in the group. Given the small group size, all evaluations were submitted with the evaluator and evaluatee names although the results of these remained confidential among the instruction group. For all the individual modules, the rubric utilized for evaluations was similar to that of the grading instructor (Appendix E, Figures E1-E3). However, the assessment form varied in the enumeration and weight of appraisal categories such that emphasis was placed upon individual contribution and research. The percentage division included the following weights: contribution (10%), leadership (10%); problem-solving skills (20%); background research (10%), practical competence (25%); quality of collated information (25%); and communication (15%). Categorical results were pooled and analyzed using a student's paired t-test.

Similar to the grading forms utilized, columns for enumeration of strengths and weaknesses pertinent to each appraisal category were added. In this way, students could justify

their reasoning for given scores as well as give accolades and highlight areas of improvement. Two supplemental question sections were present on the peer assessment form that asked the evaluator to list three items that their partner was especially good at and three items that the partner could do to improve group learning. Since these evaluations were not shared with the students, these questions were utilized to monitor group teamwork and functionality. In addition, the self evaluation form included two more question components regarding the "Virtual Vineyard": the three components that the student enjoyed most in the specific case module and the items that needed to be improved in the case module. In conjunction with the module three evaluation, a final evaluation was distributed that assessed the "Virtual Vineyard" as a whole of which the results are included in the "student perception" section.

Final evaluations. At the conclusion of the course, students completed the anonymous final evaluation that assessed the "Virtual Vineyard" in the areas of benefit to learning of viticulture, skill improvement, and overall learning. Twelve questions in the learning and skill categories required students to rate their opinions of various pertinent statements on a scale of one (strongly disagree and/or poor) to ten (strongly agree and/or excellent). A similar section consisting of three questions asked students to evaluate their overall learning in the course and effort required compared to other courses in their major and their likelihood to take another class structured similarly. In addition to the scaling questions, a written section consisting of nine questions evaluated the students' personal feelings about problem based learning, their progress in the modules and the course in general was included (Appendix E, Figure E3).

RESULTS

Student performance. Initially the instruction team was hesitant that the removal of exams and institution of problem-based learning case projects would permit all students to receive high grades, thus decreasing the effectiveness of evaluation. However, after the first module it became apparent that this was not the case. While six students received scores over 90% equating to an "A" letter grade, three earned scores between 80% and 90% resulting in a "B", three earned scores between 70% and 80% equating to a "C" grade, and two earned less than 50% or an "F" score. It should be mentioned that the two students who received the lowest grades rarely attended class, did not participate in the case, and left the course after the first module. Their partners then became a "revised" team and utilized one of the students' original cases for the following modules. While a bell curve of distribution of student scores was not apparent, such a scoring system was not traditionally utilized in the course grading previously and the average grade given was a "B".

In the second module, scores increased overall as the two students at the bottom of the course left and their two partners moved up one grade category from a "C" to a "B". One additional student also increased their score in the second module such that all students were at a "B" level or above. The last module and final composite grades echoed this result. However, while student projects were increasing in their quality, the attentiveness of students as well as their completion of suggested readings seemed to wane. Thus, "minute" papers with one to two essay questions pertinent to the previous lecture material were instituted to ensure that the material was covered and daily student participation was emphasized. At the start of these papers students were performing poorly with few scores above 50%, but by the end many of the students were in the 80 to 90% range.

Student perceptions.

Professional Skills. Though requested as an addition for all student projects, useable evaluation questionnaires were submitted by 9 of the 11 students in the first module and second modules and only 4 in the last module. A normal distribution was not apparent in the individual category results or the totaled evaluation scores in any of the modules. Despite the variation in responses noted, student evaluations revealed mean scores ranging from 91 to 98% with a wide array of standard deviations reaching from 2.7 to 8.2% (Table 5). Given the small sample size and lack of normal distribution, paired categorical results from the module one and two self and peer evaluations were to used to determine overall statistical significance of the evaluations. A student's paired t-test was then utilized to determine the significance level of the results.

It must be noted that the low response rate of evaluations in the third project module precluded strong conclusions about the mean survey scores of the last module. It was decided that given the very small sample size of the third module evaluations, statistical analyses to determine significance were not appropriate.

In the first two modules with special emphasis on the module one, students had a tendency to rate their peers higher than themselves. However, the mean peer scores decreased steadily throughout the modules and the standard deviations increased in tandem. Modifications of peer evaluation scores were such that in the last project module a mean peer score of 96% and a standard deviation of 6.9 points resulted in comparison to the higher mean score of 98% and a standard deviation of 2.7 points in the first module. Paired t-test results confirmed that the trend of decreasing peer evaluation categorical scores from modules one and two ($t=2.03$, $p= 0.05$). Conversely, the self evaluation scores rose from the first to second modules. Values also remained more consistent with mean scores from 91.1% to 94.4% and standard deviations from

4.6 to 8.2%. Results of the student's paired t-test validated the trend of increasing self evaluation categorical scores from the first to the second project module (t=2.27, p=.03).

Table 5: Virtual Vineyard Module Student Evaluation Averages

	# of Responses	Mean Score	SD	Pooled p-value
Self Evaluation				
Module One*	9	91.1	8.2	.03**
Module Two	9	94.4	4.6	
Module Three	3	95.0	4.4	
Peer Evaluation				
Module One*	9	98.0	2.7	.05**
Module Two	9	95.7	7.6	
Module Three	3	96.0	6.9	

*Evaluations of two students who left the course post Module one are not included
** Results indicate the significance of pooled self and peer evaluation categorical scores between modules 1 and 2 using a student's paired t-test (df=54, tails=2).

Problem solving. Team player and problem solving sections of the self and peer evaluation were utilized in modules one through three to determine student perception of problem solving skills. In general, students rated themselves as having a lower mean score and a greater range of scores than their group members in regard to problem solving capabilities in the first module (Table 6). However, in module two these results were reversed such that the mean self evaluation scores were slightly higher and the standard deviations lower than that of the peer assessments in regard to problem solving ability. This decrease in peer scores was apparent at an α=0.05 level of significance.

Table 6: Average Student Responses to "Team Player/ Problem Solver" Category of Virtual Vineyard Module Evaluations

Team Player/ Problem Solver *Actively participates in work; provides innovative solutions; volunteers to complete tasks*			
	Mean Score	SD	α=0.05
Module 1*			
Self Evaluation	19.0	1.7	
Peer Evaluation	19.8	0.4	**
Module 2			
Self Evaluation	19.2	0.8	
Peer Evaluation	19.1	2.0	**
Module 3			
Self Evaluation	18.7	1.2	
Peer Evaluation	19.3	1.2	

*Evaluations of two students who left the course post Module one are not included
**Indicates a significant difference between module scores using the matched pair sign test

Practical competence. Self evaluation mean scores in the practical competence portion of the assessments rose slightly from 23 out of 25 points in module one, to 23.2 in module two and to 24.3 in the last module (Table 7). Similarly, standard deviations decreased steadily from 2.3 in module one to 1.2 in module three. Ironically, just as self evaluation scores for practical competency steadily increased and standard deviations decreased, peer evaluation scores steadily decreased and standard deviations increased from a high of 24.6 to a low of 23.0 and a low of 0.9 to a high of 2.9 respectively. This decrease was found to be statistically significant at an $\alpha=0.05$ level.

Table 7: Average Student Responses to the "Practical Competence" Category of Virtual Vineyard Module Evaluations

Practical Competence *Grasps, evaluates and applies theoretical course concepts to case study; suggests realistic and rational solutions to problems; exhibits a solid viticulture knowledge base*			
	Mean Score	SD	α=0.05
Module 1*			
Self Evaluation	23.0	2.3	
Peer Evaluation	24.6	0.9	**
Module 2			
Self Evaluation	23.2	1.9	
Peer Evaluation	24.0	1.8	**
Module 3			
Self Evaluation	24.3	1.2	
Peer Evaluation	23.0	2.9	

*Evaluations of two students who left the course post Module one are not included
**Indicates a significant difference between module scores using the matched pair sign test

Contribution. The skill of communication was addressed in the "contribution" section of the individual module self and peer evaluations. A definite trend was apparent across the modules such that students consistently rated themselves higher in the contribution category than their peers (Table 8). This trend continued throughout the implementation of module one and two such that a significant downward trend of peer scores was apparent as was a significant upward trend in self evaluation scores. Furthermore, more similar responses were received from the self evaluations than the peer evaluations in modules two and three. This is especially true in modules one and three wherein peer evaluation standard deviations were 1.0 and 1.7 respectively while self evaluation standard deviations were only 0.5 and 0.6 indicating more variation in the peer evaluations.

Table 8: Average Student Responses to "Contribution" Category of Virtual Vineyard Module Evaluations

Contribution *Attends group meetings; seeks group consensus; actively articulates ideas*			
	Mean Score	SD	α=0.05
Module 1*			
Self Evaluation	9.1	1.3	**
Peer Evaluation	9.7	0.5	**
Module 2			
Self Evaluation	9.7	0.5	**
Peer Evaluation	9.3	1.0	**
Module 3			
Self Evaluation	9.3	0.6	
Peer Evaluation	9.0	1.7	

*Evaluations of two students who left the course post Module one are not included
**Indicates significant difference at α=0.05 using the matched pair sign test

Leadership. Leadership scores in the self and peer module evaluations varied in terms of mean score and standard deviation across the modules. Mean self evaluations scores were initially lower than peer scores in the first module and appreciably higher in the second and third modules (Table 9). The decrease in peer evaluation scores, though slight, was significant at an α=0.05 level Similarly, the standard deviation for self evaluations was lower than the peer evaluations in the first module though it was approximately equal in the second module and then notably lower than peer scores in the third module. Thus, while the standard deviation of peer scores varied from 0.7 to 1.7, the range of standard deviations of self evaluation scores was much smaller ranging from 0.8 to 1.2.

Table 9: Average Student Responses to "Leadership" Category of Virtual Vineyard Module Evaluations

Leadership *Approaches situation with a positive attitude; keeps group members on task*			
	Mean Score	SD	α=0.05
Module 1*			
Self Evaluation	8.9	1.0	
Peer Evaluation	9.7	0.7	**
Module 2			
Self Evaluation	9.2	0.8	
Peer Evaluation	9.6	0.7	**
Module 3			
Self Evaluation	9.3	1.2	
Peer Evaluation	9.0	1.7	

*Evaluations of two students who left the course post Module one are not included
**Indicates significant difference at α=0.05 using the matched pair sign test

Collating information. Student self evaluation scores in regard to ability to collate information increased from the first to the second module and third modules (Table 10). In addition, standard deviations steadily decreased from a high of 3.3 to a low of 1.2, indicating a smaller range of scores in the second and third modules. However, just as self evaluation scores rose, peer evaluations decreased slightly in modules one and two. The matched pair sign test corroborated this resulting trend at an $\alpha = 0.05$ significance level.

Table 10: Average Student Responses to "Collating Information" Category of Virtual Vineyard Module Evaluations

Collating Information *Helps submit requests; identifies, organizes, utilizes and synthesizes resources and extracurricular information; Identifies issues and ramifications of decisions not readily apparent*			
	Mean Score	SD	α=0.05
Module 1*			
Self Evaluation	22.2	3.3	**
Peer Evaluation	24.3	1.7	**
Module 2			
Self Evaluation	23.7	1.4	**
Peer Evaluation	24.2	1.7	**
Module 3			
Self Evaluation	23.7	1.2	
Peer Evaluation	25.0	0	

*Evaluations of two students who left the course post Module one are not included
**Indicates significant difference at α=0.05 using the matched pair sign test

Background Research. Mean scores given to group members by their peers showed a slight upward trend from 9.8 initially to 10.0 by the last module. Furthermore, standard deviations decreased throughout the modules from a 0.4 to 0 by the last module (Table 11). The matched sign test confirmed the upward trend of self evaluation scores and the slight downward trend of peer evaluation scores from module one to module two.

Table 11: Average student responses to "Background Research" category of Virtual Vineyard Module evaluations

Background Research *Completes class reading assignments; Identifies case resources needed*			
	Mean Score	SD	α=0.05
Module 1*			
Self Evaluation	8.8	1.4	**
Peer Evaluation	9.8	0.3	**
Module 2			
Self Evaluation	9.6	0.7	**
Peer Evaluation	9.7	0.4	**
Module 3			
Self Evaluation	9.7	0.6	
Peer Evaluation	10.0	0	

*Evaluations of two students who left the course post Module one are not included
**Indicates significant difference at α=0.05 using the matched pair sign test

Written comments about the modules. The self-evaluation section included written comments as to what students enjoyed most about the "Virtual Vineyard" as well as what needed to be improved. Comments were then typed to further conceal student anonymity and organized according to the type of benefit or improvement that was cited. The greatest number of comments were given in the first module (Table 12). In the second module, less comments were written (Table 13), yet they continued to fall into similar categories. The last module had the lowest response rate overall and only five comments were given (Table 14).

Table 12. Student Responses in Regard to Benefits and Suggested Improvements to the "Virtual Vineyard" post Module One

Project: Module 1	# Replies	Written Comments:
Benefits		**The components that I (the student) enjoy most about the "Virtual Vineyard" are:**
	4	Working with a group. *"The team."*
	4	Problem-solving. *"It isn't boring me, I am actually enthused. Wow."*
	4	Real-world application. *"The realism. Work made fun."*
	3	Learning and acting like a consulting firm. *"The professional approach to all the inquiries and problem solving methodology."*
	3	Working with actual sites and using real data. *"The wealth of information to be obtained, applied and commented upon."*
	2	Freedom of choice (with vineyard planting, design, etc.) *"I especially like the idea that I'm in charge of managing someone's wine grape acreage."*
Response Sum	**20**	
Improvements		**The components that I (the student) think need to be improved in the "Virtual Vineyard" are:**
	4	Lack of precise explanation. *"It was explained well, but I really feel that I never knew what I was doing."*
	2	Communication for data requests. *"Communication with the client. More means and faster replies."*
	2	Difficulty with the evaluation form. *"The evaluation form should be more user friendly; this has taken me forever."*
	1	Computer issues. *"I have a hard time accessing some of the attachments."*
	1	More pictures and data about the site *"I would love to see more detail of the site. Pretending I was there just isn't the same."*
	1	Working with a team *"Maybe not making this a group project."*
Response Sum	**11**	

Table 13: Student Responses in Regard to Benefits and Suggested Improvements to the "Virtual Vineyard" post Module Two

Project: Module 2	# Replies	Written Comments:
Benefits		**The components that I (the student) enjoy most about the "Virtual Vineyard" are:**
	4	Immediate responses and feedback. *"I liked the program with the immediate feedback. It was fun."*
	4	The "Diagnosis" problem solving software program. *"I had fun dinking and playing plant detective. I feel you really hit on something with that program."*
	4	Real-world application. *"I enjoyed this one more than the last one because it was more applied."*
	3	Varied client dialogues, tests and outcomes of cases due to software program. *"Different outcomes to problems---made you think!"* *"I liked to see al the different kinds of tests that could be done in different parts of the vine."*
	1	Working with a Team. *"Working with my group."*
Response Sum	**16**	
Improvements		**The components that I (the student) think need to be improved in the "Virtual Vineyard" are:**
	2	More time for module. *"I feel that the modules could have been spread out throughout the semester. I could have used more time on module 2 and I did not need as much time"*
	2	Increase scenario difficulty. *"Finding new pictures as we found most of them on UC Davis website. Maybe some WA pics?"*
	1	Computer issues. *"My partners were able to download the case a full week before I could. When it was downloaded, they put it on 2 computers in the student lounge area whose hours are from 8:30 to 5 and closed on the weekends.*
	1	Change module two to module three (end of the semester) *"Have this part after canopy management module."*
	1	Changes cases each module & provide solutions to the modules. *"I think that for each module, each group should get a new case study. I felt that my partner and I are stuck with this case and we have to drag it out to the end."*
Response Sum	**7**	

Table 14: Student Responses in Regard to Benefits and Suggested Improvements to the "Virtual Vineyard" post Module Three

Project: Module	# Replies	Written Comments:
Benefits		**The components that I (the student) enjoy most about the "Virtual Vineyard" are:**
	3	Real-world application. *"More applied to what is relevant."*
	1	Working with a Team. *"Working with my group."*
Response Sum	**4**	
Improvements		**The components that I (the student) think need to be improved in the "Virtual Vineyard" are:**
	1	More time for module. *"The biggest problem I have is the time constraint on the last module. There was an immense amount of work to do and very little time."*
Response Sum	**1**	

Final Evaluations. Approximately 45% of students completed the final evaluations of the course.

Contribution of course resources to learning. Overall students agreed with all twelve of the statements concerning the components integral to the learning of viticulture (Table 15). However, half of the statements received high mean scores and relatively low standard deviations such that the majority of student responses were found to be at the level of "agree" or above for the statements. Of all the possible course components, students most strongly agreed that the utilization of case study problems and the completion of assignments related to case study problem based learning benefited their learning of viticulture in the course (m= 9.2, sd= 1.3). Computer usage and electronic resources were also highly rated by students as useful in viticulture knowledge acquisition (m= 9.0, sd= 0.7, 1.0). Library resources (m= 8.4, sd= 1.1)

and lectures by the professor (m=7.8, sd= 0.5) were also determined to be beneficial to the learning of viticulture by students.

Students rated resources traditionally provided in the course such as articles and notes on WebCT and the course textbook at a level of agree overall (m= 7.6, 6.6) and slightly above neutral in their usefulness at one standard deviation (5.7, 5.5). Peers as teachers, working in groups, communicating about viticulture within learning groups and whole class discussions and team oral reports were rated at a mean level of "agree" overall. However, all of these categories, especially the working in groups and communicating about viticulture with a group, held high standard deviations such that levels of student agreement with these statements were highly varied. (Table 15).

Table 15: Student Perceptions of How Various Course Components Aided their Learning of Viticulture (Number of Responses=5)

0= Strongly disagree → 5= Neutral → 10= Strongly agree.	Mean	SD
Statement		
The extent to which students agree that the component was beneficial to:		
Learning of Viticulture		
The use of case study problems.	9.2	1.3
Completing assignments related to case-study PBL problems.	9.2	1.3
Using electronic resources, primarily the Internet, to find information.	9.0	1.0
Use of computers as an investigative tool in viticulture.	9.0	0.7
Library resources, other than electronic ones.	8.4	1.1
Lectures by the professor.	7.8	0.5
Peers as teachers.	7.8	1.9
Articles and notes provided on WebCT.	7.6	2.0
Whole class discussions question and answer sessions, or oral reports from groups.	7.2	2.6
The textbook.	6.6	1.1
Communicating about viticulture with your group.	6.4	4.6
Working in groups.	6.2	4.5
Statement		
The extent to which students agree that this course helped them to improve their skills in:		
Improvement of Skills		
The course helped me learn how to obtain viticulture information from a variety of sources.	9.2	0.8
I feel that I can apply the general principles I learned to other viticulture problems.	8.8	1.3
I feel more confident in participating in scholarly group discussions.	8.6	1.1
I am a better problem solver.	8.0	1.4
My ability to analyze and synthesize information significantly improved.	7.6	1.5
My writing about viticulture improved.	8.0	2.4
My ability to initiate tasks and overall leadership skill improved.	7.8	2.6
I am more competent in the use of computers for information retrieval and data analysis.	6.2	1.3
I think that the grading scheme in this class fairly reflects the objectives of the course.	6.0	2.0
My ability to communicate and utilize peer-reviewed literature research improved.	6.4	4.0
I feel more able to work comfortably and productively with a team	4.4	3.3
Evaluating the individual efforts of me and my group members helped our group function well.	4.2	3.0

Improvement of skills. Students agreed with ten of the twelve statements addressing how their various skills improved due to the Advanced Viticulture course. Students most strongly agreed that their ability to obtain viticulture information from a variety of sources improved (m= 9.2, sd= 0.8). All of the skill statements concerning problem solving skill improvement such as becoming a better problem solver, analyzing and synthesizing information and applying general principles learned in the course to other viticulture problems were rated by students as improved due to the course (m= 8.8 to 7.6, sd= 1.5 to 1.1). Students also agreed that their ability to participate in scholarly group discussions improved as a result of the course (m= 8.6, sd= 1.1). Overall students agreed that their writing about viticulture (m=8.0, sd= 2.4) and overall leadership and task initiation improved (m= 7.8, sd= 2.6) although large range in scores of both these items indicate that variation in student response was high such that some strongly agreed while some strongly disagreed with these statements. The two questions that students did not agree with concerned group work skill improvement. Of the responding students, they did not believe that they felt more able to work comfortably and productively with a team (m= 4.4, sd= 3.3) and that the individual efforts of themselves and their group members helped the group function well (m= 4.3, sd= 3.0)(Table 15).

Effort level, overall learning and format preference. On average students agreed that compared to other courses in their major they learned more than usual, expended more energy than usual and would participate in another course structured similarly. However, a large variation was found in responses as to students' likeliness to take a course organized in the same format such that some students would readily take a course structured similarly while others preferred a more traditional teaching approach. Conversely, while required effort was higher

than other courses, students felt that they learned more than other courses in their major (Table 16).

Table 16: Students' Overall Perceptions of the "Virtual Vineyard" (n=5)

Statement	Mean	SD
On the whole, the amount of effort required in the course was: 10= Much more than usual → 5= same as usual → 1= much less than usual.	8.2	1.9
Compared to other courses in my major, I learned: 10= Much more than usual → 5= same as usual → 1= much less than usual.	7.8	1.1
If given an opportunity, I would like to take another class structured like this. 10=Definitely Yes → 5= Maybe → 1=Definitely No	7.6	2.9

Written responses indicated that all of the students felt more comfortable with problem based learning at the end of the semester and would take a second course provided that the class was organized slightly differently. In addition, all students indicated that they benefited from the process of researching and discussing the problems. Time spent on the course averaged 3 hours per week. Furthermore, of all the modules, the student consensus was that the best module was the second one wherein they utilized the computer "Diagnosis" program to solve plant pathology issues. Positive feedback included statements such as:

> *I do like the PBL. I would take another class taught this way, it makes the class material appear as important as it actually is to learn.*
>
> *Working in a group and seeing other student's perspective on the problem (contributed most to learning).*

Discussing with group and class (members) helped (me) to look at all situations and all sides of problems to see out all possible resolutions.

Retention is better for me when I find things out for myself.

However, some students still felt unsure about the course organization and group work. Time limitations and module spacing were universally noted as areas for improvement. Half of the students indicated that they were not content with their group's working capacity and completion and spacing of the modules. Written suggestions included the following:

LECTURE INFORMATION

"More plant pathology in lecture for Module 2."

"I felt like the other groups had more initial knowledge. At times I felt like the blind leading the blind."

TIME CONSTRAINTS

"I felt that there was too much time for Module 1 and not enough for 2 and 3."

"The modules need to be more spread out throughout the semester."

ORGANIZATION

"Better guidelines."

"I think the modules should be in chronological order."

"When you are in a group and you are the only one really working on the problem, you have no choice but to learn."

Instructor Results.

Problem based learning effectiveness. In general, instructors for the course found the problem based learning methodology to be effective at increasing student interaction, problem solving skills, and application of course material to real-life situations. Student understanding of module cases increased such that advanced application and synthesis of lecture and outside

material was apparent in student performance. However, it was noted that the lack of exams seemed to instill a more lackadaisical attitude toward course reading assignments such that short "minute papers" were instituted in the last portion of the class to reinforce student responsibility.

Time. Compared to the previous course design, the problem based learning method for student learning was much more time intensive. The time normally spent developing a series of exams to follow the lecture material was typically ten hours per semester. However, the problem based learning format required time for case writing, module explanation and virtual communication with students about case information. This instruction and support time was provided primarily by a graduate student tutor under the direction of the primary course instructor. Although a daily log of activities was not kept during the project, an estimation of between ten and fifteen hours per week (160-240 hours) for fifteen of the sixteen weeks in the semester.

DISCUSSION

Positive Aspects. Given the current research involving educational methods and the benefits and drawbacks to each, a modified problem-based learning concept involving group involvement with site specific cases derived from Washington state Viticultural areas was chosen.

Despite the desire to increase student competence with the current curriculum as well as the qualitative skills of students, the success of such an endeavor in comparison with past course curricula is difficult to gauge. Numerous dependent variables affect the outcome of results such as variation in initial student knowledge, aptitude and differences in course content, instructors, course setting and many more. However, by utilizing professor-derived scores together with self

and peer assessments, an overall determination of students' aptitude in essential areas can be determined (Johnson et al. 1984). With the course redesigned such that the first module focused upon soils and principles of general viticulture, the second upon pest management and plant pathology and the third upon irrigation and further into general viticulture, material was covered in class lectures and via group projects.

Criteria grading of students revealed that those students with the least amount of knowledge and sufficient qualitative skills improved the most. While the professors' ratings of projects revealed that those students who held an "A" grade in the first modules continued completing "A" grade work throughout the remaining modules, those that remained in the course throughout the semester either increased their score one grade from the initial to the final module. Such score results indicate that student understanding of the material increased, their qualitative skills in the areas of problem solving, leadership and communication increased as well. This supposition is echoed by student assessments in the individual modules as well as at the end of the course. Self assessments showed that students rated themselves 3-4% higher in all categories of the grading rubric by the end of modules two and three compared with module one. This is especially apparent in the grading categories of "practical competence" and "leadership" in which steady improvement was noted by participants. Furthermore, final self assessments showed that the group strongly agreed with the statement "*I feel that I can apply the general principles I learned to other viticulture problems*" and "*I feel more confident in participating in scholarly group discussions*". Both of these statements imply increased knowledge and practical competence in viticulture. While such a small percentage increase may not seem like much, it may still indicate increasing confidence and understanding of course material. Students also strongly believed that they were better problem solvers as a result of this course. Perhaps one of

the most important results was that students strongly felt that compared to other courses in their major they learned more. This may indicate that the curriculum was presented in such a way that student competence increased even more than in similarly demanding courses set in a different structure wherein they were more actively engaged.

Conversely, while students agreed that their ability to initiate tasks and overall leadership ability improved as did their communication and writing skills, large variations in student responses demonstrated that some students disagreed with these statements. With such a small sample and standard deviations between 2 and 4 points, the effectiveness of this curricula modification on the skills of leadership and communication can not be verified despite past research indicating problem based teaching enhances such skill improvement (Johnson and Johnson 2004).

Student engagement is an important to a successful course. While knowledge and skill development can be encouraged, without student participation, even the best courses will fail. One of the biggest benefits of utilizing the modified problem based learning was the pronounced interest of students in the course material. Initially, students were skeptical about the methodology and their comments in the first module reflected this worry such that eleven "improvement" comments were given, but by the second module, only seven "improvement" comments were listed. Conversely, twenty positive comments were given in the first module, sixteen in the second and four in the third. The higher numbers of positive comments in comparison to negative comments in all modules may indicate that the students viewed the problem based learning curricula favorably. Moreover, the qualitative, original student-written comments prove students' profound interest in the course material with statements such as:

It isn't boring me, I am actually enthused. Wow.

Work made fun.

Such statements were made by "A" grade students as well as those in the "B" and "C" ranges thus proving that such interest was not a result of achievement alone, but of sincere interest in the subject matter. However, not all students were positive about the new curriculum and while the majority of students agreed that they would take another course structured similarly, a high variability in answers was found. The majority of students that liked the curriculum were strong supporters while those that did not were few but outspoken. Such results are a hazard of problem based learning as those students that are not enthused by the methodology may become disengaged from the subject matter in general (Schmidt et al. 2001).

In addition to overall increased student engagement and interest, student confidence increased throughout the advanced viticulture course as well. Module one self assessment scores were on average three to four points lower than those of modules two and three. Since the majority of students had never completed a course wherein problem based learning was utilized, a portion of such confidence can be attributed to the increased comfort that students felt with this new methodology over time. However, by the end of the course, students rated themselves as better at utilizing resources, having more confidence while participating in scholarly discussions, and able to apply the principles of the course in other areas.

The "real world" applicability of this modified problem based learning method is arguably the greatest benefit of this project. Providing students with realistic cases not only increased their engagement in the work as they felt that the information and skills that they were honing were integrated with the actual industry, but also increased their competence and ability to organize, analyze and apply information critically. Individual module assessments show that students consistently enjoy the "real world" application of the project such that written

comments about this component comprised twenty five percent of all positive comments listed. Furthermore, an additional twenty percent of positive comments addressed student's enjoyment of the critical thinking process including the various outcomes possible in cases, learning and "acting" like a consulting firm and the ability to work with real data to make decisions. Final assessments of the "Virtual Vineyard" were similar in that students strongly agreed that they found the use of computers, library, and electronic resources such as the internet to be beneficial to their learning of viticulture. They also strongly agreed that their ability to analyze and synthesize information significantly improved as did their ability to obtain viticulture information from a variety of sources.

Lessons Learned.

Issues. The development and implementation of the "Virtual Vineyard" in the Advanced Viticulture Curriculum is an endeavor that is positive in its outcomes, yet issues with group work, course guidelines and organization and time are apparent. These difficulties, while small in comparison to the benefits of the curriculum modification, must be addressed to ensure the future success of the course.

Group work. A multitude of research is available which proves that cooperative learning is more productive than competitive and individualistic learning in many areas. Proponents state that it promotes productivity, achievement, higher-level critical thinking, interpersonal relationships, student engagement and decreases student anxiety and stress in the classroom (Blayney 2003, Butler 1999, Johnson et al. 1997, Johnson et al. 2004, Jones 2006, Rudd 2005).

In regard to course material, group work permits students to engage in projects that are normally too intense for individual completion and investigate the views of other classmates that would not normally be addressed in individual work (Miller et al. 1999). Finally, researchers

indicate that student perception of group work tends to be more positive than individual attempts (Miller et al. 1999).

In this study, we found that those students working in well-functioning groups enjoyed cooperative learning while those that had problems with their group did not. In the final evaluation, although mean scores indicated that students strongly agreed that working in groups and communicating with their team about viticulture helped them to learn, large variation in student response was apparent.

The dichotomy of the course responses is evident not only in the final evaluations, but in the individual written module evaluations as well. While student self evaluation overall scores increased from the first to the last module, peer evaluation overall scores steadily decreased throughout the course. Even in the second module which students indicated was their "favorite" and they in turn gave themselves the highest self evaluation scores, peer evaluation scores were lower than that of the first module. Even more importantly, the overall standard deviations of peer scores increased drastically indicating that the division in regard to group satisfaction was high. While only one written comment was submitted in the module evaluations indicating that group work was an element that needed "improvement", six positive comments highlighting group work as one of the most enjoyable aspects of the "Virtual Vineyard" were included. Conversely, students also rated themselves as being less of a "team player" in the last module than in the first one.

The dichotomy of approval of cooperative learning as indicated by peer evaluations may be due to the fact that the student groups were self-chosen and thus higher-scoring students tended to choose partners that were active in their major classes and high-achieving as well. Conversely, students less connected to scholastic activities were less familiar with their peers and

tended to group together. As the course workload became more intense, high-achieving groups excelled while those in lower-achieving groups despite increasing their activity, were not as involved. Modifications to address the issue of randomly-selected groups by emphasizing group positive interdependence, increasing professor support to group interaction issues, increasing accountability within groups and focusing on interpersonal and social skill development in the classroom is suggested (Johnson et al. 2004, Lohman et al. 2000). Moreover, the best option for student group development may be the emphasis of positive interdependence of group members via joint rewards, resources and identity to increase the group satisfaction of the lower-achieving students(Johnson et al. 2004).

Guidelines and course organization. The "Virtual Vineyard" was a trial program implemented for the first time in an advanced viticulture curriculum and many of the issues regarding course improvement revolved around the overall organization and guidelines of the course. Both students and professors of the course were new to this style of teaching and thus, modifications to the course design based upon student feedback were welcomed and expected. The highest numbers of curricula improvement comments were given in the first module wherein eleven comments were submitted. Of these, lack of precise information constituted four responses, communication for data requests and evaluation form difficulties each garnered two responses while single responses relating to computer issues, site information and teamwork were gathered.

Various measures were taken to remedy the issue of improper guidance such as the development of secondary and tertiary sets of guidelines for the second and third modules respectively and lecture time utilization to explain the guidelines in class in addition to increased availability for student download from the WebCT site. Student desire for increased

communication requests were also adopted in the third module such that student submission times were increased by two days and time between responses from the tutor were decreased by two days. In fact, module two did not require communication requests by the tutor as a pre-designed program permitted instant results to students on a limited number of topics relevant to each case. Finally, the evaluation form was redesigned to ease computer input compatibility for the second and third modules.

Following implementation of the module one revisions, written student "improvements" decreased from eleven to seven. Of the newly suggested "improvements" none of the issues addressed in the first module that were modified were submitted for improvement indicating that the steps taken to improve the modules were effective. In fact, one of the more pervasive complaints in the second module was that the scenario level of difficulty could have been increased. This suggests that student guidance was perhaps too high in this module as the groups were strongly guided by the computer program as to which vine pathology issues they could examine in their vineyard cases.

Students suggested in the module evaluations as well as during the final assessment that the second and third modules of the course relating to pest management and vineyard design and management respectively should have been reversed such that the pest management module was completed at the end of the course. Reasons for this modification included the required vineyard "time warps" from pre-planting to establishment required by the pest module, lack of material coverage in class as well as time limitations. However, while this suggestion is valuable for future courses, the second module was paired with the plant physiology section which was essential to consider the important effects of plant pests and pathogens upon the overall and long-term vine health as well as the management of the vine. To remedy this issue, a viable

alternative would be to keep the "Diagnosis" program as the second module but have it as a separate case that would be concerning a neighbors' vineyard rather than the actual vineyard that the group is planning. Such a change would permit groups to not only examine new cases, but also allow the tutor more leeway in pathogen description. Rather than having to tailor each case to a group based upon the recent varietal decisions given by the consultants in the first module, the case could be completely designed prior to the start of the course.

Time. The most numerous complaints in the second and third module evaluations as well as the final evaluation were in relation to the time allotted for the activities. Students felt that the first module was the easiest yet garnered the most time (approximately 6 weeks) while the second module only earned 3 weeks and the last module 2 weeks. Since much of the module information was derived from lectures and topics became increasingly more difficult over time, the instruction group felt that project load should allow ample instruction time at the beginning of the course, with more module work due towards the end of the semester. However, student work loads for other courses conflicted with the time structure as once the module projects began to increase in difficulty and time requirements, so did the requirements of other courses.

Students were also required to complete a group research "investigation" which, while due at the end of the semester, was not completed by the majority of the groups until the final week. In addition, other courses were finishing their terms and concurrent projects conflicts became an issue for students. In light of student responses, perhaps student modules could be shifted so that an initial four week period was provided for the first module followed by three weeks for the second module and four for the final module set. While "front-loading" (placing the majority of work at the beginning of the course) would be ideal due to the large amount of projects and exams typically assigned by other courses at the end of the semester, such a task

should be approached cautiously as student and professor workloads will be increased due to lack of background knowledge provided to the student. Also, the quality of projects may be decreased while student anxiety is increased due to lack of adequate material coverage early in the course.

It is well documented that problem-based learning is a very time intensive teaching methodology not only for students, but for the teaching staff as well (Duffy & Kirkley, 2004, Johnson and Johnson 1997 Johnson and Johnson 2004, Miller et al. 1999, Amador and Gorres 2004, Deroma and Nida 2004). The results of the "Virtual Vineyard" confirmed such results as students indicated that they expended more effort in this course than other courses at an average of 3 to 4 hours per week. Professor and tutor hours were typically twenty-hours per week not including time spent in the classroom. However, given the advanced nature of the course, such expenditures should be expected on the part of the student as well as welcomed by the enthusiastic professor.

SUMMARY OF THE VIRTUAL VINEYARD PROJECT

Just as the adage, "*Give a man a fish and he eats for a day. Teach him to fish and he eats for a lifetime*" emphasizes the importance of an active teacher-learner relationship, research has shown that the effect of skill development and emotional outcomes on lifetime learning is greater than knowledge outcomes (Law 2002). The "Virtual Vineyard" project addressed the issue of effective lifetime learning in a three prong method. First, a survey of the Washington wine industry explored the demand, expectations and overall employment climate for viticulture and enology baccalaureate graduates. Second, an essential upper-tier course was reconstructed to emphasize the skills and knowledge desired by industry employers while increasing student involvement and learning via and experimental instruction method. Thirdly, the results of the project were analyzed such that both positive and negative effects of the experiment were explored to ensure that future modifications of curricula in the viticulture and enology sector could be scholastically evaluated.

Results of the industry survey illustrated that while all positions suggested in the viticulture, enology and business aspects of the industry were found to be of preferential hiring for university graduates, only the business sector, upper tier enology and vineyard manager positions appeared economically reasonable for long-term graduate placement in small operations in Washington State. Despite the increased cost of living in California, many graduates may be seduced by the drastically increased salary competition provided in the California industry. Students must be advised of the realistic salary expectations provided by the industry and should be encouraged to focus on obtaining positions which mesh with their personal and financial goals. Furthermore, despite expectations of prior internships and moderate competence in positions, on the job training will be provided to students. Thus, while

education should focus on experiential learning to familiarize students with basic "hands-on" wine industry procedures, educators should be aware that proficiency with the specific skills required by employers will likely be gained via training and use of employer-specific procedures and equipment. Finally, administration and teaching staff involved in educating future employees of the wine industry should prepare students adequately via specific courses best adapted to address the issues of the student's desired industry sector. In addition, courses should be focused upon qualitative skill development such as problem solving, critical thinking and communication skills across the curricula. Viticulture student's education should be based in general viticulture and emphasize additional topics such as irrigation, soils, plant pathology and vineyard and winery equipment while enology students should be well versed in wine chemistry, fermentation, sensory analysis and microbiology. Similarly, students interested in entering the business sector of the wine industry should have a firm understanding of marketing, accounting, wine business analysis, communication and business law and tax codes. While a wine-industry specific knowledge base must be gained, it must be done in tandem with the basic skills required for success in almost any field as well as life in general.

Numerous educational taxonomies exist to determine what type of cognition is most exemplary of true, life-long learning. And, although each vary in their approach, the skills of analysis, synthesis, application, dissemination, and evaluation as required by the "Virtual Vineyard" curricula are at the highest level of each. Many differences may have existed between the revised course and other courses in the major other than the modified problem based learning approach. However, written comments of students indicated that their increased learning in the course was due to the demand required to "*figure things out (for myself)*" "*the wealth of data available to analyze*" and the "*different outcomes from problems*" that *"made them think*". Such

skills are a cornerstone for future success as students cannot be taught all of the knowledge that they will need in their future careers, but by honing their ability to ascertain, organize and effectively utilize information to make viticultural decisions, they will be able to excel in almost any situation. Given that problem based learning is considered a "learner centric" methodology such that the students have an active role in deciding what and how they learn and requires immense independence on the part of the student, student responsibility is key (Johnson & Johnson 2004). This course modification, while not without it problems, was a model for increasing such responsibility. Many college students are trained to be "passive learners" wherein information is given to them directly and they must do little more than regurgitate facts to be assessed as "proficient" in the course (Miller et al. 1999).

Similar to the knowledge areas investigated, the long-term competence of students' qualitative skills as a result of the curricula modification cannot be determined at this point. However, the professor scores given to students emphasized the skills requested by the industry such that the grading rubric emphasized problem-solving skills and communication efficacies equally with the viticultural information presented. In this way, we are creating not just students who are good at collecting knowledge, but peers who have the skills to utilize and build upon that knowledge for the rest of their lives. By doing so, the Washington State University Viticulture and Enology Program can ensure that baccalaureate graduates are successful, the industry is satisfied with their education, and graduates are trained to be life-long industry leaders as well as learners.

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APPENDIX A.

WASHINGTON STATE WINE INDUSTRY SURVEY QUESTIONS, 2005.

WSU Viticulture and Enology Program

Industry Questionnaire

The College of Agriculture, Human, and Natural Resource Sciences of Washington State University is conducting a Viticulture and Enology Industry Questionnaire in order to gain a better estimate of the employment outlook, training available, and expected knowledge and skill sets of the Washington Wine Industry for future graduates from a four-year university Viticulture and Enology program. All of the information gained is completely anonymous and will be used in the evaluation and improvement of the program. We ask that you are as honest and in-depth as possible as the more accurate your answers, the more accurate the results will be. Please note that by participating in this study you understand that your involvement is completely voluntary and you may refuse to participate or may withdraw from the study at any time without penalty or loss of benefits. Should you have any future questions about the study or your rights as a subject, please contact Kathryn House at (509) 335-8197. Thank you in advance for your participation.

WSU Viticulture and Enology Program

Industry Questionnaire

Company Specific Information and Background

1. What is size and scope of your company in regard to grape growing and winemaking?

Winery (round to the nearest case)	Vineyard Acreage (round up to nearest acre)
(Drop down menu)	(Drop down menu)
Cases of wine produced per year	0-25 Acres
Less than 5,000 Cases	26-50 Acres
5,001-10,000 Cases	51-100 Acres
10,001-25,000 Cases	101-200 Acres
25,001-40,000 Cases	200-400 Acres
Greater than 40,001 Cases	Greater than 400 Acres

2. Please select for which jobs your company would **prefer** to employ a four-year university graduate of a viticulture and enology program (V&E) in the **next** year. Please include associated salary scale for each business, viticulture, and enology sections.

Viticulture	Salary Scale(drop down menu across from each)
Vineyard Manager	
Viticulturist	0-19,999
Associate Viticulturist	20,000-24,999
Irrigation Manager	25,000-29,999
Crew Supervisor	30,000-34,999
Other (please list)	35,000-39,000
	40,000-44,999
Enology	45,000-49,999
General Manager or VP of Production	50,000-54,999
Production Manager	60,000-64,999
Lead Winemaker	65,000-69,999
Assistant Winemaker	70,000 or above
Lab Technician	
Lead Cellar Worker or Manager	
Other (please list)	

Business
Company CEO
Marketing Director
Public Relations Coordinator
Sales Manager
Other (please list

3a. Do you expect that employees in these positions should have prior, hands-on internship experience in the field?

___Yes
___No ****Skip question 3b if answer is no

3b. If so, how many seasons of experience you expect the graduate should have for each position listed? (Drop down menu with number of seasons)

0
1
2
3
4
More than 4

4. Will you provide on the job training for those positions in which you would hire a four-year university V&E program graduate for your company?

___Yes
___No
*****Skip question 4a if answer is no

4a. How extensive will this training be?

(drop down menu)
Basic company protocols (safety, documentation, etc.)
Basic protocols and limited technical training in position (2 weeks or less)
Basic protocols and moderate position specific training (1 month or less)
Basic protocols and extensive position job shadowing (1 month or more)
Other, please list
_____

5. How competent in the necessary job functions for **each** position type would you expect new graduates of a viticulture and enology program to be?
Business Viticulture Enology

(Drop down menu for each)
Able to successfully complete **all** necessary tasks with little to no guidance
Able to successfully complete **most** tasks with no supervision
Able to complete few tasks with no direct supervision
Unable to complete needed tasks without direct guidance

6. Please select what you feel to be the five most important areas of knowledge for each study program.

Viticulture

_____ Pest Management
_____ Plant Pathology
_____ Irrigation
_____ Fermentation
_____ Wine Chemistry
_____ Wine business analysis (accounting, marketing, human resources)
_____ General Viticulture (vine anatomy and physiology, site selection, basics of vineyard development, trellising)
_____ Vineyard and Winery equipment
_____ Sensory Analysis
_____ Microbiology
_____ Computer system use; Specific Programs: _____
_____ Soils
_____ Foreign Language please list one: _____
_____ Other; please list:_____

(additional comment box)

Enology

_____ Pest Management
_____ Plant Pathology
_____ Irrigation
_____ Fermentation
_____ Wine Chemistry
_____ Wine business analysis (accounting, marketing, human resources)
_____ General Viticulture (vine anatomy and physiology, site selection, basics of vineyard development, trellising)
_____ Vineyard and Winery equipment
_____ Sensory Analysis
_____ Microbiology
_____ Computer system use; Specific Programs: _____
_____ Soils
_____ Foreign Language please list one: _____
_____ Other; please list:_____

WSU Viticulture and Enology Program

Industry Questionnaire

Business

_____ Marketing
_____ Accounting
_____ Human Resource Management
_____ Business Law and Wine Industry Tax Codes
_____ Fermentation
_____ Wine Chemistry
_____ Wine business analysis/ forcasting
_____ General Viticulture (vine anatomy and physiology, site selection, basics of vineyard development, trellising)
_____ Vineyard and Winery equipment
_____ Sensory Analysis
_____ Computer system use; Specific Programs: _____
_____ Communication
_____ Foreign Language; please list one: _____
_____ Other; please list:_____

7. Given your overall knowledge of the industry in Washington, what are the three most important qualitative skill sets of the included list do you feel to be essential for success in each category? (These will be separate answer blocks)

Viticulture	Enology	Business
(Matrix for each area of study)		
Well-developed palate	Time Management/Scheduling	
Communication Skills	Past "Hands-on" Experience in Position	
Leadership Ability	Problem-solving Skills	
General Farming Knowledge		
Basic Wine Marketing Skills		

8. At what location do you feel would be ideal for viticulture and enology education?

(Drop down box)

Pullman Campus

Tri-cities Campus

Vancouver Campus

Distance Degree Program

Other: Please Explain

APPENDIX B:

VIRTUAL VINEYARD BASE CASES

Virtual Vineyard Base Cases
Spring 2006

Case Name: *Concord Conversion*
Client: *Larry and Connie Slivovitz*
Location: *Sunnyside, Washington*
Site size: *30 acres*

Larry and Connie Slivovitz are former school teachers from upstate New York who retired ~10 years ago to follow their farming dream. They purchased an established Concord grape vineyard based upon their love of Manneschevitz and currently have the only Manneschevitz contract in the area to which all of their concord grapes are allocated. However, they have decided to diversify their operation and would like to convert 20 acres of their concord grape land into wine grape plantings. They have decided to contract with your consulting firm to analyze their site, guide variety selection, suggest vineyard design/ planting, and provide one production season of vine health analysis. Your contract provides you with $140.000 for all costs (consultation, planting (labor and materials), etc. It is your job to gather any pertinent information needed to successfully plan, plant and manage this vineyard site via client consultations, site evaluation and testing techniques.

The goal of the first phase of this project (Module 1), is to determine which variety(ies) you will suggest be planted, in what quantities (# of acres of each), and in what general area of the property (if applicable). As an expert consultant, these determinations must be made by balancing client desires/goals as well as scientific evaluation and testing of the site.

Case Name: *Country Livin'*
Client: *Nigel and Lucinda Smith-Thorton*
Location: *Walla Walla, Washington*
Site size: *24 acres*

Nigel and Lucinda Smith-Thorton have been enamored with the Walla Walla valley wine lifestyle since they tasted their first Pepperbridge Cabernet Sauvignon in 1998. As an ER surgeon and investment banker respectively, both are ready to slow down from frenetic pace of Seattle life to one which is more "back to basics" in Walla Walla. They have decided to contract with your consulting firm to analyze their site, guide variety

selection, suggest vineyard design/ planting, and provide one production season of vine health analysis. Your contract provides you with $200,000 for all costs (consultation, planting (labor and materials), etc. Furthermore, the Smith-Thortons are currently absentee landholders and are not planning to build their homestead until you have completed the vineyard. It is your job to gather any pertinent information needed to successfully plan, plant and manage this vineyard site via client consultations, site evaluation and testing techniques.

The goal of the first phase of this project (Module 1), is to determine which variety(ies) you will suggest be planted, in what quantities (# of acres of each), and in what general area of the property (if applicable). As an expert consultant, these determinations must be made by balancing client desires/goals as well as scientific evaluation and testing of the site.

Case Name: *Home Grown*
Client: *Bob and Barb Fox*
Location: *West Richland, Washington*
Site size: *32 Acres*
Bob and Barb Fox call Richland, WA, home. Born and raised in the Tri-cities area, Bob is an engineer at PNNL while Barb teaches Kindergarten at a local elementary school. A Washington wine lover, Bob would like to join the wine industry by planting a 10 acre vineyard. They have two young children, Belinda and Bryan, ages 5 and 7, and would like to eventually pass their future vineyard on to their children. They have decided to contract with your consulting firm to analyze their site, guide variety selection, suggest vineyard design/ planting, and provide one production season of vine health analysis. Your contract provides you with $70,000 for all costs (consultation, planting (labor and materials), etc. It is your job to gather any pertinent information needed to successfully plan, plant and manage this vineyard site via client consultations, site evaluation and testing techniques.

The goal of the first phase of this project (Module 1), is to determine which variety(ies) you will suggest be planted, in what quantities (# of acres of each), and in what general area of the property (if applicable). As an expert consultant, these determinations must be made by balancing client desires/goals as well as scientific evaluation and testing of the site.
Case Name: *Farmer's Fancy*
Client: *Tom and Penny Carlson*
Location: *Columbia Basin- Mattawa Area*

Site size: *50 Acres*

Tom and Penny Carlson are life-long farmers from the Columbia Basin. Vegetable growing is what they've done best, but given the good prices and popularity of wine grape plantings in the area, they've decided to diversify by planting 20 acres of wine grapes within their 50 acre site. They have decided to contract with your consulting firm to analyze their site, guide variety selection, suggest vineyard design/ planting, and provide one production season of vine health analysis. Your contract provides you with $145,000 for all costs (consultation, planting (labor and materials), etc. It is your job to gather any pertinent information needed to successfully plan, plant and manage this vineyard site via client consultations, site evaluation and testing techniques.

The goal of the first phase of this project (Module 1), is to determine which variety(ies) you will suggest be planted, in what quantities (# of acres of each), and in what general area of the property (if applicable). As an expert consultant, these determinations must be made by balancing client desires/goals as well as scientific evaluation and testing of the site.

Case Name: *Apple Conversion*
Client: *Jack and Judy Edwards*
Location: *Wenatchee, Washington*
Site size: *41 Acres*

Jack and Judy Edwards love Wenatchee and apples. However, the Red and Golden Delicious that they've been growing are barely making a profit. As an accountant for a local apple warehouse and a nurse respectively, both have full retirement pensions and are looking to plant their own 10 acre wine grape vineyard wherein they can retire in style! They have decided to contract with your consulting firm to analyze their site, guide variety selection, suggest vineyard design/ planting, and provide one production season of vine health analysis. Your contract provides you with $75,000 for all costs (consultation, planting (labor and materials), etc. It is your job to gather any pertinent information needed to successfully plan, plant and manage this vineyard site via client consultations, site evaluation and testing techniques.

The goal of the first phase of this project (Module 1), is to determine which variety(ies) you will suggest be planted, in what quantities (# of acres of each), and in what general area of the property (if applicable). As an expert consultant, these determinations must be made by balancing client desires/goals as well as scientific evaluation and testing of the site.

Case Name: *Organic Operations*
Client: *Hans and Anita DeBloem*
Location: *Mount Vernon, Washington*
Site size: *43 Acres*

In 1984, Hans and Anita DeBloem were two college students who met while living in East Lansing, Michigan. Enamored with the slow-food movement, they decided to combine their love of philosophy and nutrition by starting an organic farm in western Washington. Now in their mid-40's, the DeBloem's have twin 16-year old sons, Zephyr and Chinook, and a 19 year-old daughter, Nova. Looking to diversify from their organic vegetable and Peruvian horse raising commodities, they are planning to delve into the organic wine grape market by planting a 10-acre vineyard.

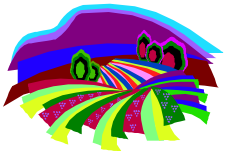
They have decided to contract with your consulting firm to analyze their site, guide variety selection, suggest vineyard design/ planting, and provide one production season of vine health analysis. Your contract provides you with $70,000 for all costs (consultation, planting (labor and materials), etc. It is your job to gather any pertinent information needed to successfully plan, plant and manage this vineyard site via client consultations, site evaluation and testing techniques.

The goal of the first phase of this project (Module 1), is to determine which variety(ies) you will suggest be planted, in what quantities (# of acres of each), and in what general area of the property (if applicable). As an expert consultant, these determinations must be made by balancing client desires/goals as well as scientific evaluation and testing of the site.

APPENDIX C.

VIRTUAL VINEYARD MODULE GUIDELINES

FIGURE C1: MODULE 1 GUIDELINES



Virtual Vineyard Guidelines & Tips for Module #1

Welcome to *Your* Virtual Vineyard!

Congratulations vineyard consultants! You have the unique opportunity to plan, plant and produce a successful wine grape vineyard for your clients. Follow the guidelines and tips given, and you'll be on your way to full production in no time!

Project Overview:

Each group has a "base case" posted in the "Discussion" section of the Virtual Vineyard link on the 413/513 Web CT site. This "base case" includes information about your client as well as some information about the site. By no means is this COMPLETE! It is your job to gather any information that you need to complete this project. This can be achieved in four different ways: client consultation, extracurricular research, site evaluation or site testing submissions via your group's discussion section on Web CT.

Your ultimate goal is to create a 5-6 page report detailing the following:

a. Proposed variety(ies) for the site with:
    i. Amount (acreage) of plantings
    ii. General location of plantings on property
b. Thorough explanation of how these decisions were made including:
    i. Specific client goals
    ii. Economics
    iii. Scientific site evaluation
    iv. Site testing results

Remember, you are presenting this to a paying client who wants an explanation of how and why you suggest certain plantings. Thus, the more concise your methodology, the happier they'll be!

Project Guidelines:

1. You are permitted to submit one of each request type (client, site eval., site testing) twice a week (Tuesday or Thursday) for return the next class period.
2. Your "grade" is calculated based upon the methodology & explanation by which you came to your report results as well as the quality of the results themselves.
3. You are required to keep track of your expenses and consultation hours spent for your site. A basic expense spreadsheet is available on WebCT for download.
4. Your feedback is very important! Questions & comments are welcome throughout the exercise and a formal evaluation will be available at the end.

Tips for Success:

1. Communication is key! Be as clear and specific as possible with your request questions as well site testing and evaluation methodology.
2. Utilize the following request sheet format for request submission. This will ensure that the data you receive accurately answers your question(s).
3. It may help you to develop a flow chart of the types of questions that you want to ask as well as how and when you'll go about asking them.
4. Many times one test or evaluation can result in gaining more than one needed answer if you think to ask ahead. Organization will help you here!
5. You are free to submit requests regarding any questions that you feel are pertinent to your case. Moreover, quality questions will yield better information than quantity questions.
6. Requests can include more than one question and /or test although multiple questions may not be submitted together if the answer is dependent upon the result of one of the other questions asked on the same submission form. E.g. Site Testing Request including Backhoe, soil sample collection and soil sample submission must be 2 separate submission forms (1 for backhoe and sample collection, one for sample submission).
7. This is an exercise in problem solving. Therefore, your grade depends upon your methodology and quality of submission requests.

Format for Requests
Utilize the following formats for submissions to increase the applicability of your requests.

Request for Client Communication – Group # and Site Name

Reason for Communication:

Statement/ Questions:

Request for Site Testing-Group # and Site Name
OR
Request for Site Consultation Visit -Group # and Site Name

Purpose of Testing:

Type of testing or consultation:

Methodology (be as specific as possible):

Figure C2: Additional Tips for the Virtual Vineyard

ALL REQUESTS MUST BE SUBMITTED IN THE 'DISCUSSION' SECTION OF WEB CT UNDER YOUR SPECIFIC CASE NUMBER TO BE SUBMITTED!!!!

Client Communication

1) Please format all client communication requests in a business letter format. While an address and date line are not needed, an opening and closing to the letter are needed. Refer to the sample communication request on Web CT for a basic example.
2) Being courteous to your client is important! Remember that all communication requests will be read by your client. The nicer that you are to them, the nicer they'll be to you.
3) You can ask your client to perform specific tasks if you wish such as collecting samples, etc. However, keep in mind that their schedules may make it difficult for them to complete the task in a timely manner. Furthermore, you must be EXTREMELY specific in your requests. Assume that you must explain exactly what, when, where, how & why the samples are taken. If you aren't sure how a sample is normally taken in the field, you can search for the information via extracurricular research. There are usually several different methods (all with their own benefits and drawbacks) to taking samples. It's up to you to choose the method that you think is best.

Site Testing

1) Specific instructions are the key to gaining the information that you want from your testing.
2) Use the "How to take a berry sample" example as a guideline for how to outline a specific sampling procedure step-by-step. Note: This is just one of many ways that this sampling can be done. The key here is that it is SPECIFIC!

Example of a specific sample request: ***How to take a berry sample***

Berry samples are very important to determine the stage and overall quality of ripening grapes. However, to make an accurate estimation of the ripening, it is very important to obtain a representative sample. The following is a step-by-step guide to obtaining a sample in a square, 5-acre block.

1. Mentally divide the block into 4 different sections. You will be walking down one row in each section, for a total of 4 rows.
2. Begin taking samples from one row by simply walking down the row and taking one berry every so often. Make sure to vary the side of the row (left or right) from where the berry is taken as well as the cluster position on the vine and the berry position in the cluster (middle, top, bottom, sides).
3. You will take 25 berries from this row, making sure that you take an equal number of samples from all through the row. Thus, by the time that you are at the middle of the row, you should only have ~12/13 berries picked.
4. When you reach the end of the row, go to the next section of the block and repeat the process until all four sections are sampled.
5. When you are finished, place all berries in a small ziplock bag and keep them aside for laboratory pick-up.

FIGURE C3:

Virtual Vineyard Module Synopsis #1 Instructions

Congratulations! After numerous site consultations, tests and client communication requests, you are ready to complete your first virtual vineyard module synopsis. The synopsis is a paper, approximately five to six pages in length (not including diagrams, references, etc.), which is meant to highlight, summarize and integrate all the work you have done on this module. Thus, while you are asked to highlight the information that you asked in your requests, it is most important that detail the WHY behind your variety selection and the path by which you came to this conclusion. It should be organized into sections as follows:

Overview

In this section you should begin by briefly describe your base case (location, client background, etc.) followed by the varieties that you have decided to plant on the site, in what amounts, and on what part of the property. You will explain the methodology behind your decisions in the following sections therefore, you do not need to do so here.

Client Communication

Written in paragraph form, this section should highlight the following:

1. What questions you asked your client
2. Why you asked them the questions that you did
3. What information you gained from the request
4. What information you were able to interpret from the questions.
5. Any extracurricular research that you were able to complete related to these questions.

Although you may organize this section as you see fit, it may be easiest to follow the progression of client questions from those asked in the beginning to those asked in the end.

Example: Our consulting team began our client communication by asking how much the Smiths' wanted to allocate to their vineyard design and planting. By broaching the topic of finances early on with our client, we were able to ensure that we could tailor our consulting practices to their fiscal needs. We learned that they could afford $50,000/ acre which permitted us to test using lots of expensive, yet in-depth techniques such as GIS soil mapping. This is a very costly procedure (~$200/ acre) but very informative. We decided to utilize the Terra Spase company to generate such a soil map based on their customer satisfaction rating.

Site Consultation

Again, in paragraph form, you will highlight the following:

1. What procedures you completed on the site
2. Why you utilized the procedures that you did
3. What information you gained from the consultations (exact figures)
4. What information you were able to interpret from the results.
5. Any extracurricular research that you were able to complete related to these questions.

Site Testing

Yet again, in paragraph form, highlight the following:

1. What site tests you completed
2. Why you chose to use the tests that you did
3. What information you gained from the tests (specific numbers, etc.)
4. What information you were able to interpret from the questions.
5. Any extracurricular research that you were able to complete related to these questions.

Integration

This is the best section of the synopsis as it is here that you will justify how all of the client communication, site consultation and site testing requests and therefore, results, led you to make the variety selection that you did. This is your time to shine! Take care to note how you balanced any special circumstances, puzzling issues or conflicting interests to make the variety decisions that you did.

Budget

You must submit a basic balance sheet including:

Initial Budget Monies

*Itemized consultation, communication and testing costs

*Consultation Fee charged per hour

Final Balance

A 'print-out' of the Virtual Vineyard excel spreadsheet in which you documented these items throughout your analysis is sufficient.

References

All information utilized via your extracurricular research MUST be referenced. This includes, but is not limited to, journal articles, extension papers, books, websites, classroom lectures and so on.

FIGURE C4: MODULE 2 GUIDELINES

Virtual Vineyard Guidelines & Tips for Module #2

Welcome to *Your* Virtual Vineyard

Diagnosis!

Congratulations vineyard consultants! You have completed the first module of the Virtual Vineyard and are on to the next. Since you have worked so hard deciding which questions to ask, tests to run, and material to gather in order to make your varietal suggestions, you can now fast forward into the future!

Project Overview:

The vineyard has been planted and is at full production (4th leaf or greater). However, the vines aren't problem-free, and given your prior promise of one season of pest & pathogen management with vineyard design, you have been brought back to "solve" the issues facing each vineyard.

Your ultimate goal is to create a 5-6 page INDIVIDUAL report detailing the following:

c. Determined issues facing the vineyard including:
    i. Specific diagnosis of pest and pathogen problems
    ii. How and why these problems affect the vineyard's ability to produce quality grapes on a:
        1. Macroscopic level (big picture)
        2. Specific physiological scale (detail)
            a. Note: You will be asked to propose how these issues truly affect the plant in the short and long term on a cell to cell basis. For many pathogens & pests, no specific information at a cellular level is available. Therefore, based on your expertise and understanding of vine physiology, you must hypothesize the LIKELY effects.
    iii. Suggested pathway for vineyard treatment to combat these issues
d. Thorough explanation of how these decisions were made including:
    i. Specific client wants and needs
    ii. Economics
    iii. Scientific site visit results
    iv. Site testing outcomes

You will accomplish this goal via group completion of a computer assisted diagnostic program case. Just as before, the emphasis on this project and your write-up are on the methodology for your decisions for site analysis and testing. However, since this exercise does not ask you to devise your own questions and site tests, your methodology and explanation of how and why these afflictions are important to wine grape quality are of the utmost importance!

Remember, you are presenting this to a paying client who wants an explanation of how and why you suggest certain plantings. Thus, the more concise your methodology, the happier they'll be!

Project Guidelines:

5. To complete this exercise, the "Diagnosis" student player must be downloaded onto a computer. CD's will be available for "check-out" from Kat or you can download the program online from: http://www.diagnosis.co.nz/download.htm
6. After downloading the player, you can "practice" on a sample case available on the site. This will familiarize you with how to play the game or you can email Kat at: kathry40@vetmed.wsu.edu
7. The diagnosis case player is relatively easy to understand and a "help" option is available to assist you in learning how to play. While it's no Xbox 360, it's still fun!
8. On Tuesday, March 28, 2006 you will be able to access your specific case from your WebCt discussion board and have until your write-up is due on April 11, 2006 to complete the case. Since there is "no waiting" for the case responses, a few intense group problem-solving sessions should allow you to complete the case.
9. As you proceed through the case, you can save your scenario to come back to work on it when you wish. When you are finished, you must submit your final diagnosis file via email to Kathleen. It must be saved under the original name case file name to receive credit.
10. Your "grade" is calculated based upon the methodology & explanation by which you came to your report results as well as the quality of the results themselves.
11. You are required to keep track of your expenses spent for your site diagnosis. A basic expense spreadsheet is available on WebCT for download.
12. Your feedback is very important! Questions & comments are welcome throughout the exercise and a formal evaluation will be available at the end. Part of the reason that this module is computer assisted is based upon your group feedback and thus, we'd need your feedback on this "new" version.

13. The paper completed at the end is an **INDIVIDUAL ASSIGNMENT**. While you must work in groups to complete the diagnosis case, you will be responsible for completing individual papers about the diagnosis.

Tips for Success:

8. Communication is key! Be as clear and specific as possible with your case paper and macroscopic and detailed hypotheses.
9. It may help you to develop a flow chart/ diary of the types of questions that you asked as well as how and when you asked them in the diagnosis process to aid in the writing of your paper. This is especially important if you do not complete the case all at once as you may forget why you chose the path that you did.
10. Although this module is EASIER in that you can receive your results from tests, etc. instantaneously, you will be charged for most every task. Thus, you will be graded on how concise the pathway to your answer has been (ie: the less money you spend…the better your performance)
11. Many times one test or evaluation can result in gaining more than one needed answer if you think to ask ahead. Organization will help you here!
12. You are free to submit requests regarding any questions that you feel are pertinent to your case to Kat via email, phone, etc.

Don't forget to have fun with this!
You have the chance to implement all of that vine physiology, anatomy and morphology to truly understand how pests and pathogens affect your vineyard!
How cool is that?!!

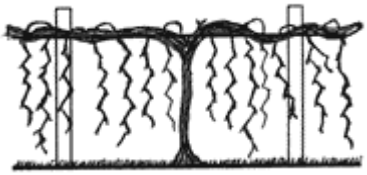


FIGURE C5: MODULE 3 GUIDELINES

Virtual Vineyard Guidelines & Tips for Module #3

Welcome to the Planting of *Your* Virtual Vineyard!

Congratulations vineyard consultants! You have completed the first two modules of the Virtual Vineyard and are at the final stage of creating your virtual vineyard! Good work! Now it's time to focus on the site planting and canopy design for your site.

Project Overview:

We're time warping back to the planting of your vineyard and in this module, you will focus on choosing the best planting design and canopy management system for the varietals that you suggested in the first module.

Your ultimate goal is to create an INDIVIDUAL 5-6 page report detailing the following:

e. The overall planting design of the vineyard
   i. Location of plantings on property (if not done in Mod. #1)
   ii. Row and plant spacing
   iii. Trellis/ canopy management system utilized
   iv. Type of irrigation system with valve location, nozzle types and preliminary schedule for season)
   v. Cropping goals for varieties
   vi. Winery contract (tons or per acre contract and expected price for each variety)

f. Specific supplies for planting with associated costs including:
   i. Posts, wires, spinning jennys, etc.
   ii. Irrigation system (tubing, nozzles, station, etc,)
   iii. Nutrient management (type of fertilizer & why utilized i.e: what nutrients gained that were lacking)
   iv. Labor for planting (hours and potential source)
   v. Extras (cover crop, cooling system, fans, bird netting, etc.)

g. Thorough explanation of how these decisions were made including:
   i. Reference to provided relevant literature articles
   ii. Specific client goals
   iii. Economics

iv. Scientific site evaluation (from previous or current module information)
v. Site testing results (from previous or current module information)

h. Final budget statement including expenses for ALL THREE MODULES such as:
    i. Consultation fees (all modules)
    ii. Planting costs (Module 3)
    iii. Testing/ site evaluation costs (Modules 1 & 3)
    iv. Pest and pathogen assessment costs (Module 2)

Since this is your last module (yeah!) you are to write this paper as if it were a final report for your paying clients. Therefore, a thorough and clear explanation of the "how:" and "why" behind your vineyard design is essential. It should be in a "business" format with specific scientific references to reinforce your decisions.

When completing this module, you encouraged to utilize any of the information gained about your site from the prior two modules in your decisions. Thus, if specific soil and topography information gained in module 1 is important for your decision, use it! Similarly, if you learned that your vineyard site had specific pest/pathogen issues in module #2, you may do your best to avoid these with some of your planting decisions. However, if you find that you need additional information not previously acquired, you can submit requests in the same format as in the first module (via your group's discussion section on Web CT) to gain any extra information.

Project Guidelines:

14. You are permitted to submit one of each request type (client, site eval., site testing) twice a week (Tuesday or Saturday by noon) for return the next class.
15. Your "grade" is calculated based upon the methodology & explanation by which you came to your report results as well as the quality of the results themselves.
16. You are required to keep track of your expenses and consultation hours spent for your site. To eliminate extra work, you can simply update your basic expense spreadsheet utilized in the previous modules.
17. Your feedback is very important! Questions & comments are welcome throughout the exercise and a formal evaluation will be available at the end.

Tips for Success:

13. Communication is key! Be as clear and specific as possible with your request questions as well site testing and evaluation methodology.
14. Utilize the following request sheet format for request submission. This will ensure that the data you receive accurately answers your question(s).
15. It may help you to develop a flow chart of the types of questions that you want to ask as well as how and when you'll go about asking them.
16. You are free to submit requests regarding <u>any</u> questions that you feel are pertinent to your case. Moreover, quality questions will yield better information than quantity questions.
17. Requests can include more than one question and /or test although multiple questions may not be submitted together if the answer is dependent upon the result of one of the other questions asked on the same submission form. E.g. Site Testing Request including Backhoe, soil sample collection and soil sample submission must be 2 separate submission forms (1 for backhoe and sample collection, one for sample submission).
18. This is an exercise in problem solving. Therefore, your grade depends upon your <u>methodology</u> and <u>quality</u> of submission requests.
19. <u>Utilize the resources provided in the 'Virtual Vineyard' section of WebCT to help determine baseline costs for your planting decisions as well to choose your canopy management system.</u>

Format for Requests

Utilize the following formats for submissions to increase the applicability of your requests.

<u>Request for Client Communication – Group # and Site Name</u>

Reason for Communication:

Statement/ Questions:

<u>Request for Site Testing-Group # and Site Name</u>
OR
<u>Request for Site Consultation Visit -Group # and SiteName</u>

Purpose of Testing:

Type of testing or consultation:

Methodology (be as specific as possible):

APPENDIX D:

VIRTUAL VINEYARD M ODULE GRADING RUBRIC

Virtual Vineyard Grading Rubric

Case Study:
Student Name:

Appraisal Category	Strengths	Weaknesses	Score
Leadership & Teamwork * Practices teamwork, including consistent communication with team members * Completes peer and self assessments thoroughly and thoughtfully			/15
Problem-Solving Skills * Illustrates high level critical thinking and problem-solving skills * Presents a solution which is comprehensive and addresses issues not readily apparent			/25
Practical Competence * Solutions are rational and realistic * Demonstrates clear and concise case- solving methodology * Evidence of a strong understanding of practical viticulture * Utilizes financial resources effectively			/25
Collating Information * Organizes, utilizes and synthesizes course resources and extracurricular information to strengthen and support solutions * Materials incorporated are appropriate and accurately referenced			/20
Communication *Produces effective client communication requests (respectful, targeted inquiries; well-written; answered clients' questions) *Employs a clear and concise writing style			/15

APPENDIX E:

VIRTUAL VINEYARD EVALUATION FORMS

FIGURE E1.

Virtual Vineyard
Peer and Self-Assessment Instructions

Congratulations! You have completed the first module in the "Virtual Vineyard" and are ready to write your peer and self assessments! This is your chance to give your opinions and suggestions for your improvement as well as that of your peers and the course.

When completing your assessment forms, please keep in mind the following:

1. These responses are confidential. Your answers will not be shared with others outside of the teaching group without your consent.

2. A portion of your project grade is dependent upon the thoroughness and objectivity of your assessments.

3. Your grade WILL NOT be affected by your opinion of your own work or the "Virtual Vineyard". Thus, try to be as honest as possible with your own evaluations as well as that of your peers and the course.

4. If you have any comments on items not addressed in the assessments, please feel free to include them on an additional sheet.

5. Your assessments are very important and are an essential part of your education and course improvement. Please take your time with this evaluation process to ensure honest and objective responses.

6. Treat yourself! You have accomplished a very intense learning task and deserve a big reward for all of your hard work!

FIGURE E2:
Virtual Vineyard Self-Evaluation Form

Case Study:			
Student Name:			
Appraisal Category	**Strengths**	**Weaknesses**	**Score**
Contribution Attends group meetings; seeks group consensus; actively articulates ideas			**/10**
Leadership Approaches situation with a positive attitude; keeps group members on task			**/10**
Team Player/ Problem Solver Actively participates in work; provides innovative solutions; volunteers to complete tasks			**/20**
Background research Completes class reading assignments; Identifies case resources needed			**/10**
Practical Competence Grasps, evaluates and applies theoretical course concepts to case study; suggests realistic and rational solutions to problems; exhibits a solid viticulture knowledge base			**/25**
Collating Information Helps submit requests; identifies, organizes, utilizes and synthesizes resources and extracurricular information; Identifies issues and ramifications of decisions not readily apparent			**/25**

In this module, I was especially good at: 1. 2. 3.
I could improve my work in the next module by: 1. 2. 3.
The components that I enjoy most about this module in the "Virtual Vineyard" are: 1. 2. 3.
The items that I think need to be improved in the "Virtual Vineyard" are: 1. 2. 3.

FIGURE E3:

Virtual Vineyard Peer Assessment Form

Case Study:			
Student Name:			
Appraisal Category	**Strengths**	**Weaknesses**	**Score**
Contribution Attends group meetings; seeks group consensus; actively articulates ideas			**/10**
Leadership Approaches situation with a positive attitude; keeps group members on task			**/10**
Team Player/ Problem Solver Actively participates in work; provides innovative solutions; volunteers to complete tasks			**/20**
Background research Completes class reading assignments; Identifies case resources needed			**/10**
Practical Competence Grasps, evaluates and applies theoretical course concepts to case study; suggests realistic and rational solutions to problems; exhibits a solid viticulture knowledge base			**/25**
Collating Information Helps submit requests; identifies, organizes, utilizes and synthesizes resources and extracurricular information; Identifies issues and ramifications of decisions not readily apparent			**/25**

My group partner was especially good at:
1.
2.
3.
My group partner could improve group learning by:
1.
2.
3.

FIGURE E4. FINAL EVALUATION FORM

VIRTUAL VINEYARD EVALUATION FORM – HORT 413/ 513

For items #1 – 25, please indicate your agreement with the statements on a scale of 1-10:
10= strongly agree; 5 = neither agree nor disagree; 0 = strongly disagree

For #1 - 11, indicate the extent to which you agree that these course components were beneficial to your learning of viticulture.

1. The use of case study problems.
2. Working in groups.
3. Completing assignments related to case-study PBL (problem-based learning) problems.
4. Communicating about viticulture with your group.
5. Peers as teachers.
6. Whole class discussions, question and answer sessions, or oral reports from groups.
7. Lectures by the professor.
8. The textbook.
9. Articles and notes provided on WebCT.
10. Using electronic resources, primarily the Internet, to find information.
11. Library resources, other than electronic ones.
12. Use of computers as an investigative tool in viticulture.

For #13 - 24, indicate the extent to which you agree that this course has helped you to improve your skill in the following areas.

13. My ability to communicate and utilize peer-reviewed literature research improved.
14. I feel more confident participating in scholarly group discussions.
15. My ability to initiate tasks and my overall leadership skill improved.
16. My writing about viticulture improved.
17. I feel more able to work comfortably and productively with a team.
18. My ability to analyze and synthesize information significantly improved.
19. I am more competent in the use of computers for information retrieval and data analysis.
20. I am better problem-solver.
21. The course helped me learn how to obtain viticulture information from a variety of sources.
22. I feel that I can apply the general principles I learned to other viticulture problems.

23. Evaluating the individual efforts of myself and my group members helped our group function well.

24. I think that the grading scheme in this class fairly reflects the objectives of the course.

Please answer the following:

25. Compared to other courses in my major, I learned:
    10 - Much more than usual → 5 same as usual → 0 much less than usual
26. On the whole, the amount of effort required in the course was:
    10 - Much more than usual → 5 same as usual → 0 much less than usual
    Overall, I would rate this course: 10 - excellent → 5 mediocre → 0 poor
27. If given an opportunity, I would like to take another class structured like this.
    10 – Definitely yes → 5 Maybe → 0 Definitely no

Please answer the following questions.

1. Do you feel more comfortable now with the problem-based learning format (PBL) than at the start of the semester? Would you take another PBL course? Why or why not?
2. What aspects of the course contributed most to your learning, and why?
3. What changes in the way your group worked could have improved your learning?
4. Which problem did you like most and <u>why</u>?
5. Which problem did you like least and <u>why</u>?
6. How many hours per week would you estimate that you spent on this course outside of class?
7. Do you think you benefited from the process of researching and discussing the problems? Why or why not?
8. Have the skills learned in this class made a difference in your other academic or social situations? If so, please give examples.
9. What special issues, concerns or questions do we need to know about in order to plan this course in the future?