

- * program flexibility (for non-majors and electives);
- * utilization of administrators, extension specialists or part-time professionals;
- * improved instruction (concise, focused, narrowly defined instructional assignment); and
- * utilization of particular strengths or faculty backgrounds and interests to provide a more credible learning opportunity. Although this article has primarily addressed the use of modules in the social science arena of agriculture, modules have been shown to be effective in other curricula, such as in plant science and horticulture (Cotter, Mexal and Buchanan, 1989).

Of course, modular offerings are not without their disadvantages. Gleanings from the previously referenced articles suggest these disadvantages:

- * absence of text materials specifically designed and economically appropriate for either a short course or modular time-frame and format;
- * crucial prerequisites have to be specified and enforced--there isn't enough time to review "old" material because of the narrow topic focus and time element (nine 75-minute class periods);
- * work load (assignments and exams) can easily get out of hand, especially if instructor is thinking three-credit courses instead of one-hour modules--the work load and learning expectations must be commensurate with the amount of credit at stake; and
- * once in the course curriculum, students may find the modules either too specialized or too many offered, leading to some modular courses being dropped due to poor enrollment--constant revision of curriculum is necessary during changing times.

Closing comments

In spite of potential problems, one-hour modules are a vital component to many undergraduate course offerings. Students and their advisors like the modular courses, and faculty have responded favorably as well. The 1980s witnessed an expansion of the modular courses, many by first time participants. The 1990s may see further introductions of modular courses, both by expansion of the offerings available among those curricula already sold on modules as well as those seeking opportunities from a budget weary environment.

Literature cited

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Student Characteristics and The Crossword Puzzle as a Teaching/Examination Tool

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Abstract

A single study was conducted to determine if one or more individual characteristics, or personality traits, influenced the student's ability to successfully answer questions presented in the form of a "crossword puzzle" (XWP), relative to the same questions presented in the traditional "fill in the blank" (FIB) format. The study involved 41 undergraduate students enrolled in an upper level Anatomy/Physiology course. Students were identified according to age, sex, major, class rank and the Myers-Briggs Personality Type Indicator. The data presented supports the conclusion that exams presented in the XWP format, relative to the FIB, enhance the student's success rate at acquiring the correct answers. Furthermore, XWP appear to reduce the variability in performance relative student personality type and/or learning style.

Introduction

Several characteristics and/or personality traits have been shown to influence students' success rate on exams (Minninger, 1984, Lawrence, 1986). More importantly, students are compelled to learn in a manner consistent with their personality and/or the teaching style of the instructor (Golay, 1982). As a result, instructional material is generally not presented to students in a manner conducive to all learning styles. More recently, studies involving the Myers-Briggs Type Indicator (MBTI) suggest that personality traits markedly influence the student's method and motivation for learning (Golay, 1982; Lawrence, 1986)

In a prior publication (Borcher et al., 1992) it was suggested that students taking exams in the form of a crossword puzzle (XWP) were significantly more successful at deriving the correct answer, than those taking the same exam presented as "fill in the blank" (FIB). The present study was designed to determine if the specific characteristics of age, gender, curriculum major, class rank and/or personality traits (MBTI), influence the student's competitive success on XWP versus FIB exam format.

Methods

The study was conducted to determine if one or more individual characteristics, or personality traits, influenced the student's ability to successfully answer questions presented in the traditional "fill in the blank" (FIB) format versus those same questions when presented as a "cross-

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word puzzle" (XWP). The study involved 41 undergraduate students enrolled in an upper level animal science - anatomy/physiology course. Each student was identified according to age, sex, major (Animal Science, Non-Animal Science/Agricultural or Non-Agriculture), class rank (sophomore, junior or senior) and the Myers-Briggs Type Indicator (Myers, 1962).

The study was conducted throughout the semester with each student taking eight laboratory exams. For each weekly exam, half the students received questions in the form of a XWP, while the other half received the same questions as FIB. Weekly exam formats were randomly assigned to students with the intent that each student would receive approximately half the exams as XWP. Each exam was scored as to (a) the percent correct answers, and (b) the percent incorrect answers. Furthermore, the incorrect answers were identified as to (c) incorrect spelling, (d) wrong word or (e) no attempt at answering the question.

The data were analyzed according to a completely randomized design (SAS, 1986).

Results

Tables 1 through 4 present the results obtained by comparison of success on XWP versus FIB according to the various student characteristics (i.e. major, class rank & gender, age & final grade and MBTI, respectively). With one exception, statistical differences were not detected between student majors when comparing within either the XWP or the FIB exam format (Table 1). Students majoring in Animal Science had the lowest percent correct answers for both exam formats, while the non-Animal Science/Agricultural majors had the highest mean scores. These two groups had statistically different mean scores ($P < 0.05$) for the XWP format. However, when comparisons were made within majors, the Animal Science and the Non-Animal Science/Agriculture students were significantly ($P < 0.05$) more successful at acquiring the correct answer when the exam was presented as a XWP versus FIB.

Table 1. Percent correct answers for "crossword puzzle" versus "fill in the blank" exam format relative to the student's major.

Type of Exam*	Animal Sciences	Non-Animal Agriculture	Non-Agriculture
Crossword puzzle	67.2* (5.7)	80.0* (6.7)	73.3 (15.9)
Fill in the blank	56.0 (4.3)	65.9 (5.1)	58.7 (12.2)

@ Values represent mean and SEM. Crossword puzzle values with the asterisk (*) are statistically different ($P < 0.05$) from their respective fill in the blank counterpart. Statistical differences were not detected between majors ($P > 0.05$).

Academic rank had no significant affect on the mean exam score (Table 2). Senior students had the highest mean score on both the XWP and FIB exam formats, however their scores were not statistically different from those of sophomore or junior students receiving similar exams. Both male and female students significantly improved their scores when taking the exam as a XWP. However, female students

Table 2. Percent correct answers for "crossword puzzle" versus "fill in the blank" exam format relative to student academic rank and gender.

Type of Exam*	Academic Rank			Gender	
	Sophomore	Junior	Senior	Female*	Male
Crossword puzzle	74.3 (9.3)	71.2 (6.2)	74.8 (15.2)	81.8 (6.3)	66.8 (5.0)
Fill in the blank	60.3 (7.6)	59.3 (5.1)	61.6 (12.3)	70.1 (4.2)	54.3 (3.3)

@ Values represent mean and SEM. Asterisk (*) indicates statistical difference ($P < 0.05$) between female and male students for both exam formats.

scored significantly better ($P < 0.05$) on the exams than did male students, regardless of the format used.

There was, in general, a positive relationship between student success and the age of the student, and final grade, on both the XWP and FIB formats (Table 3). However, statistical differences ($P < 0.05$) for exam format within a specific age group was detected in only those students 19 years of age or younger. Major differences ($P < 0.05$) were also noted for students 23 years of age or older, relative to each of the groups of younger than 23 years of age.

Table 3. Percent correct answers for "crossword puzzle" versus "fill in the blank" exam format relative to student's age and final grade.

Type of Exam*	Student's Age				
	19 or <	20	21	22	23 or >
Crossword puzzle	75.2*	67.5	67.6	71.7	91.8
Fill in the blank	59.7	60.8	66.8	64.6	83.4
	Student's Final Grade				
	C+ or <	B	B+	A	A+
Crossword puzzle	72.8*	57.6	66.1	78.3	98.9
Fill in the blank	51.7	44.6	58.6	71.6	81.7

@ Values represent the mean. Crossword puzzle values with an asterisk (*) statistically different ($P < 0.05$) from their fill in the blank counterpart.

Success rates on XWP and FIB exam formats were further characterized according to the students' Myers-Briggs Type Indicator (Table 4). Introverts scored significantly higher ($P < 0.05$) than extroverts when the exam was presented as a FIB. Likewise, intuitive individuals scored ap-

Table 4. Percent correct answers on "crossword puzzle" versus "fill in the blank" exam format relative to the student's MBTI personality type.

Type of Exam*	Introvert*/ Extravert	Intuitive*/ Sensing	Feeling / Thinking	Judgmental / Perceptive
Crossword puzzle	74.8 (6.1)	73.9 (4.0)	78.3 (7.5)	73.0 (3.1)
Fill in the blank	70.6 (5.8)	60.7 (3.8)	71.3 (5.7)	60.8 (3.1)
Crossword puzzle	72.9 (12.4)	74.8 (5.3)	74.0 (6.8)	74.7 (13.0)
Fill in the blank	72.5 (9.8)	62.5 (4.2)	60.8 (5.0)	59.6 (9.5)

@ Values represent mean and SEM. Asterisk (*) indicate Introvert versus Extravert (FIB) and Intuitive versus Sensing (XWP & FIB) significantly different ($P < 0.05$).

Table 5. Percent correct answers on "crossword puzzle" versus "fill in the blank" exam format relative to the students' temperament-learning style.

Type of Exam*	Intuitive - Feeling	Intuitive - Thinking	Sensing - Perception	Sensing - Judging
Crossword puzzle	98.8a (13.2)	95.5ab (10.2)	62.5b (7.4)	75.3b (3.8)
Fill in the blank	68.4ab (11.5)	70.7a (8.9)	46.3c (6.4)	64.3b (3.3)

@ Values represent the mean and SEM. Mean values within a row with different superscripts are statistically difference ($P < 0.05$).

proximately ten percentage units higher than sensing individuals for the FIB format. When the exam was presented as a XWP, each individual personality trait (introvert, extravert, intuitive and sensing) improved its test scores over those achieved with the FIB format. However, when the exam was presented as a XWP neither the introvert nor the intuitive individual had a statistical advantage over her or his extravert or sensing counterpart. Feeling versus thinking individuals, as well as judgmental versus perceptive students performed equally well on both the XWP and FIB exam format ($P > 0.05$), with the feeling and perceptive individuals generally having the slightly higher score.

The mean percent correct answers for the students' temperament/learning style (Golay, 1982) is presented in table 5. Intuitive feeling (NF) individuals taking the XWP and intuitive thinking (NT) individuals taking the FIB exam formats had significantly higher exam scores ($P < 0.05$) than did their sensing perception (SP) and their sensing judging (SJ) counterparts. Students of the SP learning style generally had the lowest scores regardless of the exam format.

Discussion

In a prior publication Borchert and co-workers (1992) indicated that students who took exams in the form of a XWP were significantly more successful at deriving the correct answers than students receiving the same questions presented as FIB. Furthermore, that study identified reasons for incorrect answers, suggesting that misspelled words were not a major source of error with either format. However, students taking the exam as a FIB were five to six times more likely to give the wrong answer, but significantly more willing to attempt the answer, than those taking the exam as a XWP.

The present study, while further supporting the enhanced student success rate with the XWP format over FIB, suggests possible relationships between success and various student characteristics. The study suggests that, on the average non-majors had higher test scores than students majoring in that discipline. It is important, however, to remember the distinction between students taking a required course (majors), relative to an elective course (non-majors) and the effects this might have on average test scores. The observation that females performed better than males, regardless of exam format, is not a new finding, nor are the relationships between final grade and/or the age of the students.

The data of particular interest and importance pertain to observations of students' personality type and learning

style, as they relate to the exam format. While the typical college student population is generally made up of fewer than 30% intuitive and/or introvert individuals (Lawrence, 1986), these students generally perform better in the academic environment (Golay, 1982; Lawrence, 1986). This was particularly evident when the exam was presented as a FIB. Intuitive individuals in particular appear to have the innate ability to sense the correct answer with the least amount of information provided, as occurs with the FIB format. Likewise, the introvert requires less outside stimuli than the extravert in his or her pursuit of academic knowledge (Golay, 1982) and is thus more likely to succeed on the FIB style exam. However, when the exam was presented as a XWP, sensing individuals were provided additional information (i.e. the size of the word and possibly letters of that word from other intersecting correct answers) which would assist them in improving their test score. The extraverted students as well would receive this additional outside stimuli, and quite possibly would view the XWP as more of a group effort, thus providing an exam format more consistent with their learning style.

Golay (1982) in his discussion of temperament-learning patterns suggests, that the NF and NT learning patterns have a distinct advantage in the academic environment, which was clearly supported by the results of this study. Once again, the instinctive nature of intuitive individuals, coupled with their desire to please the instructor (feeling type) or their willingness to compete in the classroom (thinking type) (Golay, 1982) appeared to enhance their success rate regardless of the exam format. However, when the same exam was presented as a XWP, the apparent step-by-step presentation of material and/or "game like" nature of the puzzle more closely matched the learning style of SJ individuals, thus enhancing their success with this format. The SP individual, least adapted to the academic environment, seeks the "hands on", "physical realities" style of learning (Golay, 1982). Once again the XWP format appears to more closely fit the SP learning style than did the FIB, and most certainly enhanced their success rate.

Banset (1992) has suggested that students who take exams in either the FIB or the XWP format use verbal memory skills to recall words and meanings, and to make contextual and lexical associations. However, students who take XWP exams also use visual memory to recall the appearance of the word, based on visual cues such as word length and intersecting letters. In addition, the XWP format enables students to use kinesthetic memory to recall answers by involving additional muscle movements in the recording of answers (Minninger, 1984; Banset, 1992). The horizontal or vertical placement of words and the act of entering letters one square at a time may help trigger recall.

It might be concluded that exams presented in the XWP format, relative to the same questions presented as FIB, both enhance student success rate at acquiring the correct answers and reduce the variability according to personality type and/or learning style. Such an enhancement clearly suggests some value in the use of the XWP as a teaching/examination tool.