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A Comparative Analysis of the Perceived Influence of Advanced Placement and Honors Programs upon Science Instruction

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Abstract

There are two major models for advanced science instruction in American high schools, the traditional honors program and the Advanced Placement (AP) program of the College Entrance Examination Board. Using the self-reports of teachers who were experienced in teaching honors and AP courses to students of similar academic preparation and ability, the author examined the perceived influences of program format upon the use of basic teaching techniques, the laboratory experience, the pace of the course, curricular freedom, and student creativity. One of the most notable aspects of the AP program is the speed at which teachers move through the curriculum. In the rush to prepare students for the exam, most AP teachers adopt a strong lecture format and minimize student-centered activities such as laboratory experimentation, student projects, and student presentations. When laboratory work is not assessed on the national AP examination, such experiences are sacrificed to provide time for lecture. When laboratory experiences are assessed, however, teachers respond by allocating more time for laboratory work, and by upgrading their exercises to make them more quantitative and experimental than those used previously or those used in honors classes. Although AP is associated with a loss in curricular freedom and flexibility, teachers perceive no clear influence of program format upon student creativity.

There are a variety of models for advanced science instruction in American high schools, including the International Baccalaureate (I.B.), Project Advance (Gaines & Wilbur, 1985), the Advanced Placement program of the College Entrance Examination Board, and the traditional honors program. These programs are designed to serve similar students, but are organized differently. Of these programs, the Advanced Placement and honors programs are the most widely used, and were therefore chosen by the researcher as subjects for investigation. Advanced Placement classes are intended to provide a curriculum that prepares students for a national examination by which they may earn college credit and/or advanced standing. By contrast, honors classes provide curricula which are designed on the local level to meet special criteria as established by districts, departments, or individual teachers. Knowledge of the influence of national external examinations in other countries (Farnham, 1982; Rutherford, 1985) lead the researcher to hypothesize that AP teachers would modify their curricula and teaching methodologies so as to best prepare their students for the national AP examination. It

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was predicted that in "teaching to the exam," instructors would forgo time-consuming student-centered activities and would rely more heavily upon lecture in order to quickly introduce students to the variety of material about which they would eventually be tested.

Using data from the UCLA–Cooperative Institutional Research Program's national survey of over 300,000 entering college freshmen (Astin et al., 1988; Herr, 1991) it was learned that 39% of all first-time, full-time 1988 freshmen had taken at least one Advanced Placement class, and 50% had taken at least one honors class while in high school. Data from the College Board shows that during the 10-year period from 1980 to 1990, AP science programs grew by 175%, and additional research by the author shows that honors programs grew at approximately the same rate (College Board, 1989a, 1989b, 1990; Herr, in press-b). Although there is a significant body of research concerning the Advanced Placement program (Casserly, 1968, 1969; Chamberlain, 1978; Haag, 1981; Willingham & Morris, 1986; Wimmers & Morgan, 1990), virtually nothing has been published regarding honors programs. In addition, no prior research has examined the relative influence that program format has upon the manner in which high school educators teach advanced science classes.

In this study, the perceived influence of program format upon teaching methodologies was examined. Within-subject analyses were performed using self-reports of teachers who had experience teaching both Advanced Placement and honors biology, chemistry, or physics to students with similar academic preparation and ability. By controlling for the teacher, field of study, and the academic preparation and ability level of the students, it was possible to examine those influences attributable to program format.

Methodology

Questionnaires were constructed to provide information regarding the perceived influence of program format upon science instruction (Herr, 1990). The questionnaires included 65 Likert-scale questions, as well as five free-response questions regarding teacher experiences with AP and honors courses. Although the questionnaire was lengthy, virtually all respondents completed it and gave detailed written responses, suggesting that there was significant interest in the topic. One-quarter of the questions were used to address issues raised in this study, and the other questions were used in parallel studies.

In the spring of 1989, questionnaires were sent to the teachers of AP and honors biology, chemistry, and physics at all 861 high schools in California with graduating classes in excess of 60 students. In order to increase the sample size and the population to which the findings could be generalized, additional questionnaires were mailed to 452 high schools in New York. A total of 847 teachers responded, including 358 biology, 257 chemistry, and 232 physics teachers. Of these, 155 (66 biology, 47 chemistry, 42 physics) had experience teaching both honors and AP to students of comparable ability and academic background, and also were experienced in teaching traditional college preparatory classes in the same subject. Unless otherwise stated, all results were obtained from this group.

The questionnaire asked teachers to compare various aspects of instruction in the AP and honors classes with respect to their college preparatory classes. College preparatory classes were defined as those which fulfill basic admission requirements for laboratory science coursework as specified by the University of California (University of California,

1988) or meet the New York State Regents requirements. These classes were used as an independent point of comparison in order to minimize personal biases that might accompany direct comparisons between AP and honors. Although the definition of college preparatory biology, chemistry, and physics varied slightly from school to school, such variation was not an issue, because we were only interested in the relative differences between programs, and not in specific values.

Prior to this research, there was no data base that specified the number and location of honors and AP programs, thereby precluding the calculation of precise response rates. By dividing the total number of AP examinations in each discipline (College Board, 1989a) by the average class size as determined in this study, it was possible to approximate the total number of AP biology, chemistry, and physics teachers. Using this information and the number of surveys returned, it was determined that responses were received from approximately 62% of all AP chemistry teachers, as well as 68% of all AP physics and AP biology teachers. With no similar data available regarding the extent of honors programs, it was not possible to calculate the percentage of honors or honors/AP teachers who participated, but there were no reasons to suggest that response rates for these groups were significantly different.

Within-subjects analyses were made using data provided by those 155 teachers who had experience teaching both honors and AP classes to students of similar abilities, academic preparation, and grade level. Where possible, we cross-checked these analyses by performing intergroup comparisons to contrast the responses of those who had taught only honors with those who had taught only AP, but found no significant differences. In addition, we compared the responses of teachers from different disciplines and academic and professional backgrounds and again found no significant differences in the data. The results from the New York and California samples were indistinguishable for almost every variable analyzed, suggesting that sampling biases were minimal. The fact that we obtained similar responses using these additional subgroups further substantiated the findings of this study.

An additional questionnaire was constructed and mailed to the administrators of those schools with honors or AP programs (Herr, in press-a). Three hundred sixty-one administrators completed and returned them, representing approximately half of those schools which offered AP biology, chemistry, or physics.

To provide additional insight, interviews were conducted with 19 Southern California teachers experienced in teaching advanced biology courses. The hour-long interviews made use of semistructured questions that had specific intents, but offered no answers. Such questions were chosen in order to evoke spontaneous responses to specific problems (Herr, 1990). The nonrandom sample of teachers was chosen so that there were representatives from private, public, urban, suburban, and rural high schools, as well as from schools representing the range of socioeconomic and ethnic diversity characteristic of the state. All of these teachers were experienced in teaching AP biology, and two-thirds were also experienced with honors biology. All interviews were recorded on audiotape and fully transcribed for the purpose of content analysis.[1] Once transcribed, all responses were coded for content analysis both by the researcher and a paid assistant. Intercoder reliability was 85%.

[1] Content analysis is a process for classifying communicated messages. It depends upon the judgements of trained analysts who classify or code responses on the basis of explicitly stated rules. It is an objective, systematic, and quantitative technique of studying communication (Holsti, 1968).

Results

Use of Basic Teaching Methods

Teachers of advanced science classes were asked to use a numeric scale to compare the pecentage of time various teaching methodologies were used in their AP and honors classes relative to their traditional college preparatory classes. A 9-point scale was used in which a value of 5 indicated that teachers spent a similar percentage of time using this technique as in their traditional college preparatory classes, whereas values of 4–1 indicated smaller percentages of time and values of 6–9 indicated greater percentages of time. By using a broad scale, it was possible to resolve subtle differences related to program format.

Table 1 displays the data obtained from 155 teachers who had experience teaching AP and honors science classes to students with similar academic ability and preparation. These data show that the amount of time spent on testing and evaluation was independent of the type of program used. Although a greater percentage of time was devoted to discussion in both AP and honors classes than in college preparatory classes, there was virtually no difference between AP and honors.

Of the seven teaching methodologies listed in Table 1, the one used much more heavily in AP classes than in honors classes was lecture. Both the magnitude of the difference (1.12) and the low two-tailed probability (0.00) presented a convincing case that a significantly greater percentage of time was spent in lecture in AP classes than in the corresponding honors classes. Content analysis of the interviews with honors/AP biology teachers showed that 72% mentioned that they spent significantly more time lecturing in AP than in their corresponding honors classes. By contrast, none of the teachers said that they spent a greater percentage of time lecturing in their honors classes. When the interviewer asked why teachers spent so much time lecturing, all respondents replied that it was the best way they knew of to cover vast amounts of material in a limited period of time.

As indicated by interview transcripts and written comments on the questionnaires, AP teachers often felt compelled to cover as much material as possible in order to prepare their students for the national examination. Most teachers felt that lecturing was the most efficient means of communicating a large number of concepts in a short period of time, and hence it was the technique of choice.

If teachers allocate a greater percentage of time to lecture in their AP classes than in their honors or college preparatory classes, it is obvious they spend a smaller percentage of time doing other things. The data in Table 1 suggest that AP teachers acquire the extra time for lecture by spending proportionately less time with student projects and presentations, instructor demonstrations, laboratory experimentation, and deskwork. It appears as though the AP program has the effect of reducing the variety of ways in which material is presented. Although desk work may be expendable in an advanced science setting, the same may not be said for the other methodologies, particularly laboratory experimentation.

Laboratory

To investigate the relationship between class format and laboratory emphasis, teachers were given a variety of objective and subjective questions regarding their laboratory programs. Table 2 shows that the number of days chemistry teachers allocate

Table 1

Rating of the percentage of time instructors used specific teaching techniques in advanced classes relative to their traditional college preparatory classes. (1 = much lower, 5 = equal, 9 = much greater percentage). All 155 teachers had experience teaching honors and Advanced Placement courses to students of similar academic preparation and ability, as well as experience teaching standard college preparatory classes.

Teaching technique	Honors (mean)	AP (mean)	Difference (H-AP)	Two-tail probability
Lecture	5.57	6.69	1.12	0.00
Laboratory	5.65	5.18	−0.47	0.01
Testing and assessment	5.09	5.16	0.07	0.52
Discussion	6.07	6.08	0.01	0.96
Deskwork	4.39	4.16	−0.23	0.06
Instructor demonstrations	5.25	4.92	−0.37	0.01
Student projects and presentations	5.47	4.99	−0.48	0.00

Table 2
Average number of hours of laboratory per month for AP classes and honors classes serving students of similar academic ability and preparation (N = 155).

Subject	N	Hours of laboratory work/week	
		Honors	AP
Physics	42	8.1	3.9
Chemistry	47	5.6	5.7
Biology	66	8.2	6.4

to laboratory is independent of class format, but teachers of physics and biology allocate considerably more time to laboratory in their honors classes than in their AP classes.

Originally, none of the Advanced Placement science examinations tested students in the domain of laboratory work. That changed in the late 1980s, when the AP Biology Development Committee disclosed its plan to publish 12 laboratory exercises and to assess experience with these exercises on the national examination (College Board, 1987). As part of this study, teachers were asked numerous questions regarding the laboratory component of their AP biology classes in the years preceding and following the introduction of this policy. Analysis of questionnaire data showed that implementation of the new examination format was accompanied by an 11% increase in the amount of time teachers devoted to laboratory work. Ninety-six percent of the AP biology teachers adopted one or more of the laboratories, and 76% adopted four or more of them.

Upon comparing high school and college laboratory manuals, it becomes clear that high school courses offer exercises that are generally descriptive and qualitative, but are often devoid of the quantitative analyses found in college courses. For example, a typical high school exercise might require students to observe a color change accompanying an enzymatic reaction, whereas a college exercise on the subject might require students to calculate the increase in reaction rate that accompanies the enzyme. When asked to compare the nature of the laboratory component prior to and following the implementation of the College Board's policy, 47% said that their labs had become substantially more quantitative, whereas only 4% said the reverse. In addition, 38% said that they were now more experimental, whereas only 8% claimed the opposite. It appears as though the new laboratory-assessment policy produced the desired effect in that it encouraged the development of experimentally based exercises resembling those generally offered in college.

In summary, teachers generally devote less time to laboratory work in AP classes than in comparable honors classes; however, the amount of time and the nature of the laboratory work in AP science classes appears to be easily influenced by assessment policies. It is possible that the laboratory components of AP physics and AP chemistry classes may be lengthened and modified to resemble college laboratories if such work is assessed on the national examination as it is in AP biology.

Pace, Breadth, and Depth of Course

Instructors believe that the curriculum they teach in their AP classes is significantly broader and deeper than what they teach in their comparable honors courses. In other

words, teachers introduce a wider range of topics, and cover these topics in greater detail when teaching AP. Thus, despite similar student populations, it is clear that the curricula of AP classes are generally more demanding than their honors counterparts (Table 3).

AP teachers were asked whether they would prefer to continue teaching their AP class or teach the same students in an honors setting. Of those 478 AP teachers who stated a specific preference, 150 (31%) said that they would prefer to switch to honors, and 328 (69%) said that they would prefer to continue teaching AP. Table 4 shows the result of a content analysis of the most commonly stated reasons given for why nearly one-third preferred the honors option. The most commonly given reason for this preference is that teachers felt that they had more curricular freedom when teaching honors; the second most commonly stated reason for selecting honors was that the pace in the AP class was too fast.

When individuals who had taught comparable AP and honors classes were asked to rate the relative paces of both classes it was shown that the pace of AP science classes was substantially greater (difference = 1.69, Table 3). Only 1% maintained that the pace in their honors classes was greater than in their AP classes, whereas 80% claimed the reverse, and 19% said that the paces were approximately the same.

The teacher qeustionnaire included a free-response question in which AP teachers were asked to offer recommendations to give to the AP test development committees. A total of 578 offered recommendations, 30% of which mentioned that the test date should be postponed until later in the year, representing a very high response rate for an open-ended question. A physics teacher said: "We don't graduate until the middle of June. This makes it almost impossible to get the E & M [electricity and magnetism] material covered, and leaves 5 weeks of class after the test. Somehow the test should be given later." Similarly, a biology instructor stated: "I would like to see the test administered in early June. We are rushed far too much and it's virtually impossible to finish the material."

Although part of the time pressure that AP teachers expressed was due to the breadth and depth of coverage believed to be necessary for the AP exam, a large part of it seemed to be due to the timing of the AP examination. Teachers were asked by use of Likert scale to respond to the statement "Instruction would be benefited if the AP exam was scheduled 2 to 4 weeks later in the year." Seventy-eight percent of all AP teachers surveyed said that they strongly agreed with this statement. An additional 8% said they agreed, and only 7% disagreed and 7% had no opinion.

From the preceding analysis we may confidently say that the curricula of AP science classes are considerably different than their honors counterparts. Instructors are inclined to introduce a wider variety of topics, and do so in greater detail when teaching AP. Such classes proceed at a significantly faster pace than do parallel honors classes, and this is compounded by the administration of the national examination prior to the completion of most schools' academic terms. The time pressure most AP teachers feel may impel them to rely more heavily upon lecture and other teacher-centered techniques.

Curricular Freedom

In interviews, it was common to hear comments such as: "In honors you have more time . . . you have more discussion . . . you just don't have time for that in

Table 3
Characteristics of AP and honors science courses relative to traditional college preparatory classes (1 = much less, 5 = equal, 9 = much more characteristic of advanced class). Data derived from 155 teachers experienced in teaching AP and honors to comparable students.

Aspect	Honors (mean)	AP (mean)	Difference (H − AP)	Two-tail probability
Freedom to pursue topics of special interest	6.17	5.10	−1.17	0.00
Freedom to develop one's own curriculum	6.36	5.29	−1.07	0.00
Freedom to select textbook	5.86	6.21	0.35	0.00
Stimulates student creativity	6.53	6.36	−0.17	0.33
Satisfaction derived from teaching curriculum	7.15	7.55	0.40	0.00
Breadth of class (variety of topics introduced)	6.30	6.96	0.66	0.00
Depth of class (sophistication of curriculum)	6.87	8.23	1.36	0.00
Pace of course (how fast topics are covered)	6.62	8.31	1.69	0.00

Table 4
Thirty-one percent of teachers currently teaching AP stated that they would prefer to teach advanced science using the honors format. This table records the most commonly given reasons for this preference. The total is in excess of 100% because some teachers gave more than one reason.

Reasons for preferring to teach honors:	Percent
Desire greater curricular freedom; don't want to "teach to exam."	60%
Desire to proceed at own pace; AP is too fast.	33%
Need less stressful environment; AP is too stressful.	25%
There are insufficient funds/facilities to do an adequate job teaching AP.	15%
Desire to spend more time in lab. AP doesn't afford sufficient time in lab.	11%
Want to develop student thinking skills; too much "cramming" in AP.	7%
Feel unqualified to teach AP	3%

AP. . . . I have to keep the screws tightened. We get on a topic which is very interesting to them, but we have to keep moving." Statements like this suggest that some AP teachers fail to spend much time on issues of special interest because they feel constrained to cover so much material for the examination. To determine the extent of this sentiment, those who had taught comparable AP and honors classes were asked to rate the degree of freedom they had to pursue topics of special interest in their classes (Table 3).

In analyzing the results of Table 3, it is clear that teachers experience greater curricular freedom when teaching honors than when teaching AP. It should be noted that there is little difference between AP and standard college preparatory classes with respect to the freedom teachers have to develop their own curricula or pursue topics of special interest. Most districts and/or departments have curricular guidelines for standard college preparatory courses, and teachers apparently believe that the AP environment provides them with no greater freedom than such classes. These same teachers express that the honors environment provides them with substantially more freedom in these areas than either AP or college preparatory. The College Board publishes recommended curricular outlines and previous examinations, and these apparently provide curricular guidance and/or constraint not paralleled in the honors situation. Although teachers feel greater constraints when developing their AP curricula, it is significant to note that they have greater freedom to select their texts than when teaching honors. Perhaps districts and/or schools have stricter guidelines on the adoption of textbooks for honors classes than for AP classes.

Creativity

Rather than stressing inquiry, creativity, and inventiveness, most science courses seem to rely totally upon the textbook, and typical lessons are characterized by the "assign-recite-test-discuss" format. Studies have shown that the science curriculum rarely ventures beyond the bounds of the textbook, and very rarely involves much creativity (Koballa, 1985; National Assessment of Educational Progress [NAEP] 1978). Although some researchers suggest that anticipation of achievement exams narrows the curriculum and constrains teacher and student creativity (Leslie & Wingert, 1990;

Wise & Darling-Hammond, 1983), very little data is available to substantiate this claim.

In interviews AP teachers frequently commented that they needed to "rush through the course in order to finish the text by May." Teachers often mentioned that they did not have the time or the freedom to pursue issues of special interest, and did not have time to perform the experiments that they desired. Although it is rather difficult to quantify "creativity," it is assumed that teachers may be able to judge those environments that foster it or stifle it. Table 3 shows that those who had taught comparable AP and honors classes believed both formats stimulated student creativity more than traditional college preparatory classes, but that there was little difference between AP and honors. In a parallel study, college admissions officers from the 200 colleges receiving the most AP students were asked to specify which programs they thought were better at fostering student creativity. Of the 157 (79%) who responded, nearly 50% said that they could not differentiate the two, and the other 50% were split almost evenly between the two programs (Herr, in press-a). When the same question was asked of 361 high school administrators, the results were similar. Thus, the responses of teachers, admissions officers, and administrators were all in agreement in that they perceived that both formats were equally effective in stimulating student creativity. It is necessary to emphasize that this data is based only upon perceptions, and it is essential that objective research be conducted before any conclusions are made.

Summary and Implications

It is clear that AP classes are generally more demanding academically than their honors counterparts. Teachers introduce a wider range of topics in AP and cover them in greater detail than in corresponding honors classes. Because AP classes are rarely afforded additional time, teachers generally compensate by covering the curriculum more rapidly. As hypothesized, most AP teachers adopt a strong lecture format and minimize time-consuming student-centered activities such as laboratory experimentation, student projects, and student presentations. It appears as though they adopt this strategy in order to provide a maximum amount of time to introduce the range of topics dictated by the examination.

Approximately one-third of AP science teachers expressed a desire to switch to an honors format if it were practical, primarily because they felt the AP pace was too rapid and influenced them to forgo special topics or time-intensive teaching strategies. Although the AP program continues to grow, administrators, school boards, and the College Board should take note of the significant amount of discontent among teachers resulting from time constraints. School officials should consider options that would provide more time for such courses, and the College Board should consider postponing the test date by one month so that it corresponds to the end of the academic year of most high schools, thereby providing more time for instruction. In addition, the AP Biology Test Development Committee should consider returning to a format where students are allowed to select one of two possible questions in each subsection of the free-response portion of the examination. Although this may create problems in standardizing the grading of the examination, it would give teachers a sense of greater freedom in developing their curriculum, because they would not feel as pressured to cover every topic in greater detail, and could focus more on principles and concepts than on specific facts. While the AP program appears to restrict curricular freedom,

it is not clear if this influences student creativity, suggesting the need for further research in this area.

The National Advanced Placement Examination appears to have a significant influence on the curricula in AP classes. In those instances where the College Board's AP examinations do not assess laboratory work (AP chemistry, AP physics, pre-1988 AP biology), such experiences may be sacrificed to provide time for lecture. The AP Biology Development Committee attempted to address this problem by developing a series of recommended laboratory exercises as well as a policy of assessing understanding of laboratory concepts and procedures on the national examination. In response to this policy, there was a significant change in the emphasis given to laboratory activities in AP Biology classes througout the nation. Not only was more time allocated to laboratory work, but the laboratory exercises were more advanced and experimental than those previously used, or those used in corresponding honors classes. The AP Physics and AP Chemistry Test Development Committees should consider adopting similar policies if they want to influence the laboratory curricula in a similar fashion.

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