

*Assertion 1: When directly asked about the nature of scientific knowledge, its truth value, and its independence from human existence, a large number of students responded with views which are commensurate with an objectivist epistemology.*

Table 3 shows that 27 to 29 students (75-81%) of the students hold views of the nature of scientific knowledge commensurable with objectivism. They believed (a) that science is not artificial but based on facts (18), (b) that scientific knowledge is correct or false/artificial (6), and (c) that science is the only correct vision of nature (4). These students also assigned truth value to scientific knowledge. Most of them (21) believed that it is either a matter of time until all incorrect laws and theories are eliminated and until scientific knowledge is equivalent to the truth. For some (4), this process of eliminating false and incorrect scientific statements is unequal for different branches of science. Accordingly, scientific knowledge is only approximating truth rather than being the truth. Students holding views commensurable with objectivism also believed that scientific laws and theories exist independently of humans, or that they are an expressions of what nature really is. The following statement is representative of these students' views.

Scientific knowledge is always progressive, as technologies allow man to see more clearly and to renew and improve old theories. Thus as techniques move forward, more and more is known and man moves closer and closer to understanding. Science is always a progressive art... For this reason, barring catastrophe, scientific knowledge will always be approaching the ultimate and complete truth.

insert Table 3 here

A minority of students (19-25%) held views which were commensurable with a constructivist-relativist view of nature. They believed that science is only a partial view, or one of many views, of nature. As a consequence, absolute truth does not exist and is relative to human constructions. Some students argued that scientific laws and theories are manmade because humans want to understand nature. The laws and theories arise out of the purposeful endeavor to achieve this understanding. The integrated and differentiated views of these students are well expressed in the following statement:

A scientist has a way of describing the universe's reasonably consistent patterns, so does an artist or a writer. Some say the scientist is the more accurate. Yet accuracy is a funny word to use when describing modes or stylistic algorithms that all by nature involve presumptions. Somewhere between them seems to lie the balance of human understanding.

## The Nature of Scientific Knowledge: Content Analysis

Question	Answer categories <sup>‡</sup>	Frequency
1. Scientific knowledge is artificial and does not show nature as it really is.	Science is not artificial but based on facts (O)	18
	Science consists both of artificial (false) and correct (true) knowledge (O)	6
	Science is the <b>only</b> correct vision of nature (O)	4
	Science is only partial view of nature (I)	3
	There are multiple world views and science is just one of them, not more and not less correct (R)	5
2. Scientific knowledge more and more approximates truth.	It is only a matter of time until scientific knowledge is the truth (O)	21
	Science not only approximates but in fact is truth (O)	4
	Because of different rates of progress in its branches, science approximates truth in some areas but not in others (O)	4
	Truth is relative and absolute truth does not exist (R)	7
3. Scientific laws and theories exist independent of human existence. Scientists merely discover them.	Laws exist with nature whether there are humans observing nature or not (O)	22
	God created the universe with all its laws before man. Man only discovers God's code (O)	3
	Science is man made but reflects nature as it really is (O)	2
	Science is but one method of explanation for natural phenomena (R)	4
	Science is a purposeful human endeavor (R)	3
	Science is based on presumptions (R)	2
4. Science, like art, religion, commerce, warfare, and even sleep, is based on presuppositions.	Science is truth based on fact (O)	9
	Prior scientific knowledge affects future work (O)	8
	From presuppositions to truth (O)	4
	Sometimes (I)	4
	All human knowledge is based on a priori assumptions, or has unquestioned roots/origins (R)	11
5. The social environment of a scientist will not influence the content of the knowledge he or she proposes.	Science based on numerical fact which cannot be changed by the scientists social environment (O)	5
	Rewards and recognition drive scientists to research in specific areas (O)	3
	Scientists are impartial and thus not influenced by their social environment (O)	3
	Equipment determines the areas a scientist researches and with it the knowledge he/she proposes (O)	3
	Depends on scientist. Some are influenced, others are not (I)	2
	There are cultural influences and institutions affecting the work of a scientist (R)	12
	Language and perception are determined by the social environment and thus affect the results of scientific work (R)	5
	Zeitgeist determines what research is important and how it is to be interpreted (R)	3

<sup>‡</sup> We assigned the students answers to three categories, objectivist (O), relativist (R), and intermediate (I).