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Construction of Reasoning Capsules and Study of its Effects on the Students Studying in Standard VIII

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Abstract:

In the context of today's dynamic educational landscape, characterized by rapid technological progress and evolving research methodologies, this research investigates the construction and effects of reasoning ability development capsules on eighth-grade students. The study delves into the imperative of nurturing well-rounded individuals by fostering cognitive faculties, analytical reasoning, and problem-solving skills. It contends that education should transcend traditional knowledge-centered pedagogy to focus on aptitude-centered, skill-based approaches that cultivate enduring proficiencies. The study emphasizes the need for early-stage aptitude development to bridge the gap between conventional education and the requirements of competitive exams.

Using a robust experimental design, the study employs Pre Test, Post Test, and Re-Test phases to assess the impact of reasoning ability capsules on students' performance. The findings highlight the effectiveness of the capsules on reasoning abilities, demonstrated by increased mean scores in post-test evaluations. Moreover, the study investigates the capsules' influence on different IQ levels, revealing significant enhancements in reasoning ability for both higher and lower IQ students. The results underscore the need for tailored approaches to optimize learning outcomes, particularly for students with diverse aptitudes.

The research findings hold significant educational implications, advocating for the integration of reasoning ability capsules into classrooms. The study suggests that such interventions can benefit students, parents, and educators alike, while the retention of effects is noteworthy across variables like intelligence quotient, geographical area,

Institute types, parents' educational level, annual income, and gender. Ultimately, the research underscores the need to cultivate cognitive attributes early, ensuring a holistic approach to student development and fostering enduring proficiencies.

Keywords: - Capsule, Primary School, Reasoning, IQ

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1. Introduction

In the contemporary era characterized by rapid advancements in science and technology, the landscape of knowledge is undergoing continual expansion, facilitated by relentless research endeavors and the evolution of research methodologies. This dynamism is reflected in the incessant evolution of educational curricula, necessitating a unique and refined role for educators. The proliferation of technology and research breakthroughs has enabled students to access diverse internet-based educational media and multimedia tools, albeit limited to specific societal strata, consequently engendering disparities in intellectual quotient (IQ) levels and skill acquisition among learners. Addressing this divide mandates equitable access to resources and the formulation of comprehensive curricular frameworks to foster holistic student development. In the present educational milieu, characterized by an amplified emphasis on technological integration and research-driven insights, education's purview has dramatically expanded in the first half of the 21st century. Recognized not only as an agent of individual growth but also as a cornerstone of national progress, education assumes a pivotal role in shaping future citizens and professionals. Consequently, the imperative of nurturing adept, well-prepared students assumes prominence. The trajectory of a nation's development is intricately intertwined with the quality of education imparted within its educational institutions. Beyond imparting subject-specific acumen, education assumes the responsibility of cultivating cognitive faculties, refining analytical reasoning, and honing problem-solving and decision-making proficiencies.

Moore and Bruder (1996) illuminate the indispensability of reasoning skills in fostering lucid, logical thinking, given that solutions to complex issues necessitate cogent argumentation and cogent distinctions. This aligns with Doronila's assertion that education should equip students with competencies enabling informed decision-making and efficacious societal participation. Historical pedagogical luminaries, including Socrates, Plato, and Aristotle, have long emphasized the centrality of reasoning skills in fostering astute academic analysis and informed life choices. Acknowledging the salience of reasoning aptitude in cognitive development and personality refinement underscores the significance of its assessment among secondary school students.

The contemporary educational landscape is tasked with recalibrating instructional paradigms to optimize learning outcomes. Essential to this endeavor is the cultivation of students' skills for effective academia and problem-solving. This study aspires to enhance student development by gauging their reasoning abilities during the later stages of primary education, thus augmenting their cognitive maturation. Notably, prevailing education systems often perpetuate apprehension toward subjects, failing to stimulate students' innate potential or foster an intrinsic passion for learning. Consequently, there is an imperative to transition from knowledge-centered pedagogy to aptitude-centered, skill-based approaches that nurture enduring proficiencies, untethered from transient memorization.

The observed dearth in competitive exam results, particularly in aptitude-based evaluations, underscores the misalignment between traditional education and the cultivation of nuanced aptitudes. Aptitudes, distinct from rote knowledge, crystallize over extended periods, necessitating early-stage cultivation. In contrast, contemporary students often embark on competitive exam preparation post schooling, affording insufficient time for genuine aptitude development. The study contends for early aptitude-focused pedagogical interventions to incubate and refine vital cognitive attributes.

In summation, the current research underscores the evolving educational milieu shaped by technological advances and dynamic research pursuits. It emphasizes the need to transcend conventional education paradigms, advocating for a shift toward

Aptitude-centric instruction to nurture enduring cognitive faculties. Ultimately, this realignment holds the potential to equip students with the skillset imperative for their multifaceted roles in a rapidly evolving society.

1.1 Statement of the Problem

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1.2 Importance of Study

The study's significance lies in its potential utility for various stakeholders. Education's pivotal role in human development necessitates precise assessment of individual capabilities. Conventional assessment of student abilities based on academic performance and teacher observations lacks scientific rigor. Intelligence tests, though commonly used, inadequately predict learning potential and occupational aptitudes beyond cognitive aspects. The burgeoning importance of diverse aptitudes in varied occupations underscores the necessity of aptitude tests. This research addresses the inclusion of reasoning ability measurement in competitive exams for clerical, officer, and specialized roles, as well as in the National Genius Test by NCERT. Developing reasoning skills is vital, encompassing distinct components. By focusing on five key components, tailored tools can be devised to assess and enhance reasoning ability among eighth-grade students.

The resulting literature finds versatile applications. It aids student evaluation, gauging problem-solving inclinations, while guiding students and parents towards suitable educational paths. Researchers can leverage this tool, fostering logical thinking. Furthermore, parents can discern their child's reasoning aptitude, informing career choices. Schools can organize games, puzzles, and competitions based on this approach. Ultimately, the research motivates educators to formulate capsules nurturing students' logical application skills.

1.3 Objectives

1. To prepare capsules for developing reasoning ability.

2. To examine the effectiveness the prepared capsules experimentally to enhance the reasoning ability of the students of Std. VIII.
3. To examine the effect of capsules on reasoning ability in the context of I.Q.

1.4 Hypotheses

H_{O1} There will be no significant effect of capsules on the reasoning ability of the students.

H_{O2} There will be no significant effect of capsules on the reasoning ability of high I.Q. level of students.

H_{O3} There will be no significant effect of capsules on the reasoning ability of low I.Q. level of students.

1.5 Definition of Terms

Definitions of the terms used throughout are as mentioned below:

- **Construction:** The Webster's Dictionary (1969), gives the meaning as, to put together the parts in their proper place and order to build up, to erect to form. According to P.G.Terry (1977), construction means, programmed instruction term for the construction of an answer either in writing or by performance actively, not by passive choice.
- **Reasoning:** According to Arno F. Written (1997), Reasoning means, attempt to solve problems by combining two or more aspects from past experience. According to R.P. Taneja (1989), Reasoning means, Thought process involving influence or problem solving making use of general principles. Reasoning means putting two or more elements of past experience together to solve a novel problem.
- **Capsule:** A systematic algorithm or set of steps to solve or approach any reasoning question.
- **Study:** Application of the mind to the acquisition of knowledge, as by reading, investigation, or reflection.
- **Effectiveness:** Fraser (1994, p. 104) defined it as, this is a measure of the match between stated goals and their achievement. It is always possible to achieve 'easy', low-standard goals. In other words, quality in higher education cannot

only be a question of achievements 'outputs' but must also involve judgments about the goals (part of 'inputs'). Enhancement in reasoning ability of the students due to implementation of the programme experimentally.

2. Research Method

The significance of research rests upon its methodology, shaped by the nature of the problem. Thus, selecting an appropriate method is crucial for yielding standardized outcomes. John W. Best (1963) emphasizes experimentation as a potent approach, enabling controlled manipulation of elements and observation of effects in scientific laboratories. Among diverse methods, the experimental approach holds the highest caliber. This research adopts the Pre Test, Post Test Retest Design, a robust experimental design.

3. Experimental Design

To achieve practical solutions, comprehensive planning from inception to conclusion is imperative. Proper experiment planning offers several advantages:

- Provides a clear research direction.
- Enhances precision and result dissemination.
- Facilitates efficiency in research execution.
- Minimizes time, energy, and financial wastage.
- Anticipates and comprehends potential issues during experimentation.
- Enables proactive problem-solving.

Scientific, logical, and problem-relevant planning of research methods and tools enhances clarity and reliability of results.

3.1 Selection of Content

The current study's content selection aligns with the fundamental mathematical principles covered in the eighth-grade curriculum. This encompasses processes such as Addition, Subtraction, Multiplication, and Division, alongside general knowledge of familial relationships, English Alphabets, and their sequential arrangement. This comprehensive approach enables assessment of diverse

reasoning abilities. The subsequent sections elaborate on the reasoning ability development capsules and their information.

3.2 Selection of Design

Experimental design of the present research was one group – Pre Test, Post Test and Retest Design.

3.3 Construction of Tool

The study encompassed the construction of a Reasoning Ability measurement tool, incorporating Pre-Test, Post-Test, and Re-Test stages. A central objective was the development and evaluation of self-learning study material, termed "Capsules." The process entailed specific steps: selection of reasoning types aligned with student age, determination of appropriate difficulty levels for Std. VII students, labelling and structured explanation of reasoning tests, expert review, and instructional implementation. The study material covered distinct reasoning types: Number Series, Alphabet-Based Series, Number and Alphabet Series Combined, Coding-Decoding, and Blood Relationship Puzzles. This material served as the foundation for a 50-question multiple-choice test employed for Pre-Test, Post-Test, and Re-Test phases. The test's validation involved input from 20 experts including educators and guides, leading to refinements. The finalized test, derived from this iterative process, was utilized across all test phases, facilitating a comprehensive assessment of reasoning ability.

Other Tools: To assess student IQ, the Desai Verbal-Non Verbal Group Intelligence Test by Dr. Krishna Kant Desai was employed. The test's reliability was established through Test-Retest (0.75) and split-half (0.88) methods, indicating robust consistency. Test validity was confirmed with a correlation coefficient of 0.78 between verbal and non-verbal test scores. The test comprised 88 items, with 8 items explained prior to administration, leaving 80 items for student completion.

Data on students' gender, locality, institution type, parental income, and educational background were collected using an Information Schedule, enhancing the study's contextual understanding.

3.4 Population and Sample

The research population constitutes the primary group of experiment participants, from which the study's sample is derived. The research's outcomes can be extrapolated to this population, contingent upon a precise definition. Clarity on the population definition is imperative, as conclusions drawn from the sample hinge on this definition's accuracy. Proper population delineation is essential to ascertain the specific characteristics of potential participants. Given that population attributes evolve with time, location, and study criteria, population size must be circumscribed.

3.4.1 Population:

In this study, the researcher defined the population as "Students enrolled in the academic year 2011-2012, attending eighth grade in Gujarati medium secondary schools within the Gandhinagar district." The population parameters were established according to the following criteria:

- Area: Gandhinagar District
- Medium: Gujarati
- Educational Standard: Standard VIII of Secondary School
- Duration of time : Year 2011 – 2012

3.4.2 Selection of Sample:

Opting for the entire population as a sample entails excessive time and financial investment, as well as heightened research complexity. Consequently, selecting a representative sample curtails resource wastage and intricacies while enabling research outcomes to be generalized to the broader population.

In this study, the assessment of prepared reasoning ability development capsules for eighth-grade students necessitated a strategic approach. Schools granting permission and ensuring time allocation, along with the cooperation of principals and teachers, were purposively chosen. The sampling process unfolded in two stages:

- Sample for try-out
- Sample for the main experiment

3.5 Planning of the Experiment

Data collection and implementation of the experimental procedure were executed in accordance with pre-acquired school principal permissions. The following timetable was uniformly adhered to across all selected schools for conducting the experiment:

Time / Periods Allocated	Details
1	Filling up of information schedule
2	Conducting IQ test
21	Explaining the 50 Capsules (Teaching)
2	Post Test
2	Retest

3.6 Data Collection

The data collection methodology serves as the cornerstone of the research design, embodying its essence. The investigator meticulously followed these steps to ensure the acquisition of reliable and valid data:

- The investigator initiated contact with the selected school principals in alignment with the research plan to secure necessary permissions.
- Prior to the commencement of the experiment, the Desai Verbal-Non Verbal Group Intelligence Test was administered to the sample to assess student IQ. Subsequently, completed answer sheets were collected within the stipulated time frame.
- Employing the test's designated scoring scheme, the investigator marked and tabulated the participants' responses, subsequently converting them into IQ scores.

3.7 Classification of Data

The students' IQ test scores were utilized to compute the median, subsequently facilitating their categorization into two distinct levels: upper and lower.

3.8 Analysis of Data

The evaluation of the prepared capsules' efficacy was accomplished through the implementation of a one-way analysis of variance, which involved a comparison between the scores acquired during the Pre-Test and Post-Test phases. To further assess the experiment's influence on independent variables such as IQ and parents' educational status, the F-Test statistical analysis was employed. Additionally, the retention of acquired skills was determined through the application of F-Test, involving the examination of scores from the T2 and Re-Test phases. Furthermore, an F-Test was conducted, taking into consideration the gain scores and the different levels of the independent variables to comprehensively analyze the experimental outcomes.

4. Classification, Analysis and Interpretation of Data - Effect of Capsules

One of the primary aims of this research was to evaluate the impact of the developed capsules on students. Utilizing reasoning ability-based capsules, students underwent educational sessions. Before the program, the T_1 test was conducted, and after the program, the T_2test was administered. Subsequently, calculations involving n, $\sum X$, $\sum X^2$, M, and SD were performed for each test based on the T_1 - T_2 scores. These computations are presented in Table 4.1(a).

	Pre Test	Post Test
N	213	213
$\sum X$	3350	6644
$\sum X^2$	57191	231088

M	15.52	31.19
SD	5.27	10.60

4.1(a) n, ∑X, ∑X², M, SD were calculated on the basis of T_1 and T_2

Analyzing the data from Table 4.1(a), it becomes evident that the mean scores of the post-test surpass those of the pre-test. To verify the authenticity of this score difference, further assessment was warranted. Additionally, in alignment with the research's null hypothesis (H_{O1}), an ANOVA was performed. The ANOVA summary findings are encapsulated in Table 4.1(b).

Source of Variable	Df	SS	MS	F - Ratio	Remarks
Between Group	1	26171.18	26171.18	372.94	**
Within Group	424	29754.30	70.18		
Total	425	55925.48			

Table 4.1(b) Summary of ANOVA on the basis of Table 4.1(a)

fo_1=6.70 and fo_5=3.86 for df_1=1 and df_2=424(400)

It is observed from Table 4.1(b) that the calculated value of F-ratio of students is 372.94. The table value of F-ratio for df_1=1 and df_2=425 (400) at 0.05 and 0.01 levels are 3.87 and 6.72 respectively. Here the calculated value of F is higher than the tabular value of F at 01 level of significance. Hence, the null hypothesis is not accepted at 01 level. So it can be concluded that the increase in the mean score on the post test of the students is actual which shows the effectiveness of the capsules on reasoning ability of students.

4.1 Effect of Capsules on I.Q. Of Students

4.1.1 Effect of capsules on students having higher I.Q. level

One of the objectives of the present research was to assess the effect of prepared capsules on students having higher I.Q. level. Students were educated by taking aid of capsules based on reasoning ability. Before this program T1 test and after

this program T2 test was administered. On the basis of the scores of T1 - T2 n, ∑ X, ∑X2, M, SD were calculated for each test. This is shown in Table 4.1.1.1(a).

	Pre Test	Post Test
N	107	107
∑X	1923	3864
$\sum X^2$	37333	148372
M	17.97	36.11
SD	5.11	9.13

4.1.1.1(a) n, ∑X, $\sum X^2$, M, SD were Calculated on the basis of T_1 and T_2

According to the data of Table 4.1.1.1(a) it is understood that Mean scores of post-test are more than those of pre-test. It is necessary to testify that the difference in score is actual or not. Apart from this, hence the null hypothesis HO4 of the present study was also to be assessed, ANOVA was conducted. The summary of this ANOVA is presented here in Table 4.1.1.1(b).

Source of Variable	Df	SS	MS	F - Ratio	Remarks
Between Group	1	17605.05	17605.05	321.54	**
Within Group	212	11607.57	54.75		
Total	213	29212.62			

Table 4.1.1.1(b) Summary of ANOVA

on the basis of Table 4.1.1.1(a) fo_1=6.76 and fo_5=3.89 for df_1=1 and df_2=212(200) It is observed from Table 4.1.1.1(b) that the calculated value of F-ratio for higher I.Q. level students is 321.54. The table value of F-ratio for df1 = 1 and df_2=212 (200) at 0.05 and 0.01 level are 3.89 and 6.76 respectively. Here the calculated value of F is higher than the tabular value of F at 01 level of significance. Hence the null hypothesis is not accepted at 01 level.

Conclusively, the rise in the mean score on the post-test for students with higher I.Q. levels signifies the capsules' effectiveness in enhancing the reasoning ability of this specific group of students.

4.1.2 Effect of capsules on students having lower I.Q. level

One of the objectives of the present research was to assess the effect of prepared capsules on students having lower I.Q. level. Students were educated by taking aid of capsules based on reasoning ability. Before this program T_1 test and after this program T_2 test was administered. On the basis of the scores of T_1 - T_2 n, $\sum X$, $\sum X^2$, M, SD were calculated for each test. This is shown in Table 4.1.2.1(a).

	Pre Test	Post Test
N	106	106
$\sum X$	1382	2780
$\sum X^2$	19858	82716
M	13.04	26.23
SD	4.19	9.66

Table 4.1.2.1(a) n, $\sum X$, $\sum X^2$, M, SD were Calculated on the basis of T_1 and T_2

According to the data of Table 4.1.2.1(a) it is understood that Mean scores of post-test are more than those of pre-test. The difference in score is actual or not is necessary to testify. Moreover, one way ANOVA was undertaken, hence the null hypothesis H_{O5} of the present study was also to be assessed. The summary of this ANOVA is presented here in Table 4.1.2.1(b).

Source of Variable	Df	SS	MS	F - Ratio	Remarks
Between Group	1	9218.88	9218.89	166.23	**
Within Group	210	11646.42	55.46		
Total	211	20865.30			

Table 4.1.2.1(b) Summary of ANOVA

On the basis of Table 4.1.2.1(a)fo_1=6.76 and fo_5=3.89 for df_1=1 and df_2=210(200) It is observed from Table 4.1.2.1(b) that the calculated value of F-ratio for students having lower I.Q. level is 166.23. The table value of F-ratio for df_1=1 and df_2=210 (200) at 0.05 and 0.01 level are 3.89 and 6.76, respectively. Here the calculated value of F is higher than the tabular value of F at 01 level of significance. Hence the null hypothesis is not accepted at 01 level. Conclusively, the rise in the mean score on the post-test for students with lower I.Q. levels signifies the capsules' effectiveness in enhancing the reasoning ability of this specific group of students.

5. Major Findings

5.1 Findings related to the effectiveness of the experiment

- The capsule prepared to develop the mathematical reasoning ability was found to be significantly effective at 01 level.
- In the context of the intelligence level the experiment was found to be effective on the participants having higher intelligence quotient and the participants having lower intelligence quotient at 01 level.

5.2 Findings related to the effectiveness of retention of the experiment

- The effect on retention was not found to be significant on the experiment at 01 level which means that the increase in the reasoning ability of the students by the capsules prepared is durable.
- Assessing the effect of retention in the context of the intelligence level, the effect of retention was not found to be significant on the participants having higher as well as lower intelligence level at 01 level.
- The effect of the experiment was found upon the participants of the experiment having lower intelligence quotients.

6. Educational Implications

The utility of research findings within the realm of education is of paramount importance; otherwise, research endeavors are rendered futile. The current study's findings, if implemented in actual classrooms, stand to benefit students, parents, and educators alike.

This study encompassed variables such as intelligence quotient, geographical area, institute types, parents' educational level, annual income, and gender. The experimental results indicated significant effects of the program on each of these variables at the 0.01 significance level. Consequently, it can be inferred that conducting a similar project in any school in the future could yield efficacious outcomes across these variables.

Additionally, the study's focus on variables like intelligence quotient, geographical area, institute types, parents' educational level, annual income, and gender revealed that the program's retention effect remained significant for each variable at the 0.01 level. This suggests the potential for the longevity of program effectiveness across these factors in future school-based initiatives.

Furthermore, the study's observation that students with higher intelligence quotient achieved greater gains than those with lower intelligence quotient underscores the importance of stratifying participants into distinct groups based on intelligence quotient through IQ testing. It also emphasizes the need to concentrate efforts on students with lower intelligence levels to enhance their gains. In educational settings, similar abilities should be fostered, with special attention to students possessing lower intelligence quotient, to ensure their development and improvement.

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