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Efficiency of SRI Model of Learning

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Authors' contributions

This work was carried out in collaboration between all authors. All authors read and approved the final manuscript.

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ABSTRACT

The goal of this study is to prove the efficiency of *SRI* (Separate Relevant from Irrelevant) model of learning. The present paper offers two studies. One was conducted on the sample of 82 fifth-grade students (aged 11 to 12 years) attending elementary-level schools in Banja Luka, while the second study focused on 36 school lessons, with six researchers from the Faculty of Philosophy and four elementary school teachers coming from the same schools as students of the first sample. The first study findings have shown that: (a) *SRI* model of learning yields better effects in fact memorization (content retention) in comparison to traditional-style teaching, (b) *SRI* model results in higher level of enjoyment during mother tongue lessons (statistically significant), and nature study lessons (not statistically significant), (c) *SRI* model contributes to decreased level of negative emotions during school lessons, and (4) students aged 11 to 12 are reported to acquire sufficient mastery of *SRI* model of learning. The second study has provided evidence that: (a) the SRI model results in higher level of learning efficiency, i.e. higher level of students' engagement during lessons, (b) in SRI learning model, group interaction results are recorded better in comparison to individual work.

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1. INTRODUCTION

In traditional teaching model students are rarely instructed how to learn efficiently. They would simply perform unselective memorization of the entire content. *SRI* (Separate Relevant from Irrelevant) model of learning is based on CTML theory [1]. According to CTML theory, students engaged in learning are encouraged to be involved into cognitive information-processing. To help students learn more efficiently, the content is presented in verbal and visual representations of the content structure (ibid.). CTML has proven to render better activation of working memory and facilitate longer retention and integration of the learned material [2].

SRI model is primarily focused on teaching students how to disregard the memorization of the entire content, but how to focus their attention to separating the relevant from the irrelevant content. The activity of self-explanation, if applied during learning process, establishes better relations to previous knowledge, and refines mental models for further learning [3]. In order to separate relevant from irrelevant, a student needs to understand paragraphs he/she reads, i.e. ideas conveyed by the written content. Berthold, Eysenck, & Renkl [4] showed that self-explanation enhances the level of conceptual and procedural learning [4].

2. THEORETICAL FOUNDATION OF THE PRESENT RESEARCH

We live in a learning civilization. Those who learn to learn quickly and easily will achieve freedom and self-actualization in XXI century.

2.1 Learning by SRI Model

Once the relevant information has been separated, students can easily turn their attention to conceptualizing the pattern or structure of the presented information. Students learn deeper, memorize the content better, and understand it more efficiently if it is not presented in words alone, but in words and pictures together [5,6]. Schematic representation of material contributes an improved interaction during learning process [7]. In the same research, students aged 11 to 12 were instructed how to separate relevant from irrelevant, memorize more efficiently, and make schematic representation of the learning content. Peer interaction has proven to foster significant improvements in all the above aspects (ibidem).

The same holds true for math learning. If teachers provide conceptual instruction prior to problem-solving, it yields higher level of sequential work on the learning material, and higher student engagement [8]. If students are exposed to conceptual instruction, prior to learning or problem-solving, the knowledge they construct will be greatly influenced. The experiment recorded the increased level of procedural and conceptual knowledge, accompanied by the reduced level of teacher's intervention (ibidem). When*SRI* model of learning is applied, students learn conceptually because they separate ideas and attribute relevance to them.

When graphics are added to words, i.e. when verbal lessons are accompanied by graphics, students tend to learn more deeply and improve knowledge retention [6]. In order to understand a concept or a paragraph of written text, students should be able to grasp author's ideas, that is, to convert it into a proposition, statement or a question. To be able to do so, students are encouraged to ask questions relating to any one idea that is conveyed by the text. This is the underlying principle of the SRI learning model. Students are advised to establish referential connections between ideas [2], and this is exactly what*SRI* model instructs them to perform.

2.2 Specificities of SRI Model of Learning

Traditional-style education is primarily based on learning through listening or watching teacher's presentations. There is very little individual work in such learning style. Dale's "Cone of Experience" gives a model on how people remember things based on how they encounter information [9]. People remember 10% of what they read, 20% of what they hear, 30% of what they see, 50% of what they see and hear, 70% of what they say and write, and 90% of what they do (ibidem). As long as students listen and observe to their teachers, they are more or less passive participants in the educational process; however, if students choose to ask questions and search for answers, dare to rely on their own experience, or the experience of peers and teachers, as well as content provided by their textbooks, students participate in a process of active learning. If teachers are inclined to have

their students ask questions about teaching materials and their own cognition, they may as well direct their attention to contents outside textbooks, e.g. the internet and other sources of information. *SRI* model is built around the process of asking questions about teaching materials. As such, the model itself is well-suited for various school subjects since it gives teachers tools to foster higher level of students' participation.

Paragraphs may be defined as parts of text conveying an idea. If we convert those ideas into questions, that is, if we reduce them to concept level or perform dual coding, we may have something close to Atkinson's keyword method in vocabulary learning [10,11]. There are many classifications that tackle the issue of mnemonic methods of learning and human memory, however, the majority of psychology textbooks still offer classification of learning methods that are valid for both humans and animals [12-15]. Examining individuals with best performance in speed memory, the author has developed ten techniques for more efficient and rational memorization [16]. To achieve improvements in that respect, it is necessary to break away from conditionality, trial and error, recognition and problem solving approach, as traits of Procrustean model of learning. Humans learn in a different way than animals although it can be said that some basic learning principles are shared between humans and animals. Animals, however, cannot perform mathematical learning, cognitive mapping, speed reading, etc. Needless to say, human learning is essentially quite different from animal learning.*SRI* model of learning is, of course, specific to humans. Tracking the sequence of ideas, asking questions and separating the relevant from the irrelevant, are not traits that can be found in animals. Certainly, there is no dispute about the fact that SRI model of learning is a textbook example of a learning type.

It is almost impossible to understand messages carried by an idea without understanding the content of the written material. In order to be able to ask questions about a text, a student first needs to understand the content. This process of understanding involves the ability to connect his/her prior knowledge and experience to the learning material at hand, and to question oneself what new ideas the text brings, all in order to arrange his/her thoughts in a meaningful set of words and phrases. The connection between words and phrases is assumed to be accompanied by mental images (nonverbal code) [17,18]. The present research does not provide any insight into students' imagination process; however, additional research is needed to clarify that issue.In any case, to build a coherent mental representation from the presented material, in the form of questions, involves understanding and abstract thinking, two of the major traits of the *Cognitive Theory of Multimedia Learning* (CTML), [19]. CTML is essentially about separating the relevant from the irrelevant.

The foundation of SRI learning model is built around student's ability to construct cognitive map of the presented text, once all paragraphs and ideas from the text are converted into meaningful questions. When the main idea is set at the top or in the middle of the structure, students make their own internal representation of the structure and bring about structural knowledge, which is more deeply embedded and longer-lasting [19]. *SRI* learning strategy is model-based approach [20]. Model-based learning enables students to transfer the acquired knowledge on the novel content. Some authors refer to it as generative processing.

2.3 SRI and Student Performance Assessment

Not only does the *SRI* learning model provide advantages in terms of processing the teaching materials, but it also gives an opportunity for a different approach in student performance assessment. For instance, if students manage to work out a question for each idea or a read paragraph of the text, he/she may be awarded with a point. For a successful attempt to single out the most important idea, he/she could get three points. If three more important ideas of the material are addressed, and students get two points for each of them, we will eventually have a very admirable testing tool for gauging progress in *SRI.* Essentially, students are given new teaching materialand their performance may be assessed once they had utilized SRI [2] found that grading of ideas breeds stronger motivation among students, and reported that mental imagery contributes to knowledge retention, as well as to increased level of student enjoyment in class (ibidem).

If we assume that student assessment is as important as what is taught and learned at schools, we must say that student performance assessment in traditional schools faces challenges on regular basis. Traditional teaching gives teachers a pivotal role in student performance evaluation. What is more, teachers

are often solely in charge of appraising students, and giving them passing grades. Students are often left without an adequate feedback on their achievement. As a consequence, they end up without proper information on their future work andways to improve their performance.*SRI* model offers solutions in that respect as it gives students a chance to compare their questions to those of their peers, and to see immediately what might be wrong with no arbitration coming for their teacher's side. This even opens space for some forms of self-assessment.

2.4 Towards Mastering SRI Model of Learning

SRI model of learning is by no means meant to be mastered in the course of a single lesson. Same as with the process of mental imagery reported by Denis [21] and Hagerty [22], students need to be introduced to this model of learning in a gradual manner.The following three steps are advised if a person is to master *SRI* model of learning: (a) distinguishing between graphic representations of phonemes, notions and ideas, (b) asking questions about every presented idea, and (c) selecting the most important ideas that require answers and memorization. The model is about generating and organizing ideas. These are two necessary components for good writing skills, as was reported by Juel, Griffith, & Gough [23]. Student's writing skills are therefore strengthened by the utilization of*SRI* model of learning.

When teachers verbally present new lessons, or when students get engaged individually into text processing, the resulting outcomes may be the lack of understanding (reproductive or mechanical learning). Students have many pejorative terms for such type of learning – cramming, mugging or swotting. *SRI* is impossible if students do not understand the content. To make it even more straightforward: Is it even possible to ask questions about the gist of an idea if we don't understand it? One of the questions may be:*What does it mean?* but this still shows that we are unsure of the essence of the presented text, and that would not be counted as the right question. Guan, Ye, Wagner, Meng., & Leong [24] reported that understanding of a phenomenon contributes to writing performance. A body of research evidence supports the contention that reading and writing skills are closely related [25-27,23]. The following assumption may be in the focus of the future research: the utilization of*SRI* model of learning can foster more efficient writing performance in students.

An experiment performed by Suzic & Radonjic [28] reported that improvement in speed reading and text comprehension. Besides, this research has proved *SRI* model yields an increased level of student engagement in comparison to traditional-style learning models (ibid.). Researchers have also found that pre-school development of reading skills significantly influences reading achievement in elementary-school-age children [29]. *SRI* model of learning has proved efficient among secondary-school-age students; here we try to prove its efficiency when applied among 11 to 12 year old students (elementary school children).

There are two key issues in this paper: (1) whether the SRI model learning is more effective than traditional teaching, (2) in which aspects can be identified that efficiency.

3. METHODOLOGY

To test the applicability of the *SRI* model of learning on 11 to 12 year old students, two experiments were performed. Both of them address the issue of *SRI* efficiency. The first experiment tested students' performance, whereas the second experiment dealt with the lessons the students attended to. The participants were the same for both experiments. The applied scientific method for each experiment will be given separately.

3.1 The First Experiment

The first experiment tested students' performance. The starting hypothesis is that students who utilize the *SRI* model of learning will: (1) perform better at memorizing content, (2) increase class enjoyment, (3) reduce negative emotions, and (4) adopt *SRI* model of learning.

3.1.1 Methods

In this study, we used the experimental approach. The nature of the phenomenon under investigation is such that it requires an experimental approach. The methodology that we use here allows reproducibility of research, and this is the condition of scientific value.

3.1.2 Sample

The participants were students from four elementary school classes of two Banja Luka

elementary schools. Namely, students from classes V1 and V3 of "Ivo Andric" elementary school (total of 41 participants), and students from classes V1 and V3 of "Georgi Stojkov Rakovski" elementary school (total of 41 participants) constituted the entire sample. The students from "Ivo Andric" Elementary school were chosen to represent experimental (E) randomly (decision had been made by tossing a coin). The same teaching materials were provided for all four school classes, and they included language lessons in *Verb Tenses, Direct and Indirect Speech,* and *Synonyms* for mother tongue lessons;the nature study lessons were *Forest, Water and Vegetable Garden.*

3.1.3 Procedure

The following were the steps of the experimental procedure. First, the participants underwent initial measurement performed by means of the following instrument: (a) *Scale of enjoyment in peer learning communication – SEPLC,* (b) *Thermometer of emotions – TE,* (c) *Scalar of group belongingness – SGB,* and (d) tests designed for SRI model utilization (*Initial test for mother tongue lessons* – ITMTL, *Final test for mother tongue lessons – FTMTL, Initial test for nature study lessons –ITNSL,* and *Final test for nature study lessons* – FTNSL). Second, the participants were introduced to *SRI* model of learning in three phases. In phase one, teachers provided some essential explanations related to the role of graphemes, phonemes, letters, words and notions within a text; the participants were also taught that words are graphical combinations of letters which carry meaning, sentences start with capital letters, end with a full stop and are graphic representations of thoughts. Meaningful combination of sentences gathered around the leading one, constitute an idea. Ideas are usually expressed in longer forms of the written text called paragraph (graphical representation of an idea). The students' assignment was to convert ideas into notes or questions. The class teachers had been delegated to read paragraphs of written text, while students needed to assign one question to every expressed idea. Students then individually decided which of the questions the most important one was. In phase two, students were split into groups, each of which was given a set of questions. The participants' task was to get all group members agree on which of the questions would be nominated for each of the processed paragraphs. The groups then presented their questions to classand then looked for answers in their textbooks.Presentation needs to be done so as to ensure learning takes place among all classroom students. Students had spent some time discussing the matter and, assisted by the teacher, decided which question was the most important one. In the third phase, the participants were instructed to recognize the paragraphs, i.e. ideas, ask questions, decide which question was the most important one, and select three more questions they had also found to be important. These four selected questions should be learned. Finally, the experiment included the retesting procedure (final testing), processing and interpretation of data.

3.1.4 Instruments

All instruments were designed around the nature of responses provided by the participants. In this experiment, we used four experiments. (a) *Scale of enjoyment in peer learning communication – SEPLC* (instrument designed for the purpose of this research). Initially, this instrument had 23 items that were answered on by the participants in the format of typical five-level Likert scale, with responses ranging from *1 = totally disagree* to*5 = totally agree.* The performed factorization on the instrument left 19 items remaining (α = .83) in four subtests:competence and enjoyment (α = .84), reward and social affirmation(α = .77), altruism (α = .75), and aversion towards social devaluation of learning (α = .54). This instrument measured enjoyment in interaction during learning process, with one of the items reading: I enjoy being complimented for helping a peer. The second instrument was labeled *Thermometer of emotions – TE* [30]. It measured four emotions: joy, sadness, happiness and dissatisfaction. The participants described their feelings on the scale from 1 (freezing point) to 100 (boiling point). Cronbach's alpha for the positive emotions was respectable (α = .84), same as for the negative emotions (α = .87). This instrument was used twice, at the beginning and at the end of the experiment. The third instrument was *Scalar of group belongingness – SGB* (Suzić, manuscript in preparation). Initially, this instrument had 40 items, 20 of which were related to belongingness to the group of outside-school friends, and the remaining 20 were related to belongingness to group of school friends. The performed factorization on the instrument left 27 in two subtests: belongingness to group of outside-school friends (13 items; α = .93), and belongingness to group of school friends (14 items; α = .92). One of the questions

within *belongingness to group of outside-school friends*subtestread: *I feel most comfortable showing my feelings in front of my outside-school friends;* a question related to *belongingness to group of school friends* read: *Thanks to support of my classroom peers, I have become a more independent person.*The fourth instrument was comprised of relatively small battery of tests: *Initial test for mother tongue lessons* – ITMTL (α = .65), *Final test for mother tongue lessons – FTMTL* (α = .63)*, Initial test for nature study lessons – ITNSL* (α = .79)*,* and *Final test for nature study lessons* – FTNSL (α = .80). These tests measured the level of fact memorization (content retention). The mastery of *SRI* model learning among (E) group students was recorded by tallying the number of correct questions for each paragraph. No special instrument was designed for this purpose as the required measurement procedures were rather straightforward and objective, including nothing but observation and counting of the number of the right questions.

3.1.5 Results

The results of this experiment indicate that during the application of SRI model increases the speed of reading, and comprehension. In addition, SRI model strengthens the positive and reduce the negative emotions during learning.

The first hypothesis was that (E) group students, those who utilized *SRI* model of learning, would perform better at learning than (C) group students. Table 1 shows the results sufficient to confirm the hypothesis.

The initial testing provided no significant difference in mother tongue lesson results though the (C) group recorded higher scores in terms of fact memorization (knowledge retention) (t = –1.92; p = .058; Table 1). The efficiency of *SRI* model in fact memorization corroborates what Leopold & Mayer [2] found in their work, in which working memory was recorded to be more activated if students were more cognitively challenged.If students are engaged into process of grasping the ideas conveyed by the material, they allow self-explanation to prompt conceptual and procedural knowledge (4). Although initial testing of fact reproduction in (C) group showed more efficiency (t = 3.13; p = .002; Table 1), (E) group caught up with it during *SRI* model of learning utilization due to the fact that *effect size* grew from$d$ = .17 to$d$ = .81 in favor of (E) group, statistically significant at .001 level.

Cognitive domain of Bloom's taxonomy sees remembering (retrieving of previously learned information) as being low-order category in terms of its difficulty [31]. SRI method is closer to the analytical method, rather than phonetic. About efficiency of the analytical and phonetic method wrote Mitford Matthews [32]. Education is still based on the reproduction of learned material mostly because of is practicality when students' performance needs to be assessed. This seems further to consolidate the notion that schools are defined by what and how they assess students' achievements. Analysis, synthesis and evaluation, though being higher-order category of cognitive processing, remain thus outside of assessment and grading systems of today's education. *SRI* model of learning purports to lead students towards deeper learning through analysis of written paragraphs of text (ideas), and enables them to recognize main ideas, the ones that most attention should be devoted to, i.e. those that should be remembered. Table 1 gives enough evidence in that respect forboth school subjects, mother tongue and nature study lessons. Here we do not provide experimental analysis in school subjects such as math and physics, but it would be interesting to gain insight into the efficiency of *SRI* model of learning for these two school subjects in future research.

We have also hypothesized that *SRI* model would increase class enjoyment. Table 2 does not supply evidence needed to prove such an assertion. The experiment showed that (E) group students enjoyed classes of mother tongue more (t = 3.03; significant at .003 level), as for the classes in nature study, (E) group reported higher values than (C) group, (M = 4.20) vs. (M = 4.05) respectively, though not statistically significant (t = 1.11). So, the second assertion of the main hypothesis can only be upheld by the findings from mother tongue classes, but we dare to surmise that longer-lasting experiments would offer enough evidence that students' class enjoyment level would increase in other school subjects as well. SRI model of learning leads students to autonomy, and autonomy to a higher level of enjoyment in teaching [33-35]. Class enjoyment is particularly important when we think of the effects it has on lifelong learning. Efficient learning is only to be expected if students have mastered how to learn and how to enjoy when learning.

Table 1. Differences between experimental (E) and control (C) group in initial and final measurements of fact memorization

Measurement	School subject	Experimental (E)			Control (C)			Difference	Significance
		M	*SD*	*SE*	*M*	*SD*	*SE*	*t*	*p*
Initial	Mother tongue lessons	.54	.27	.04	.66	.29	.05	–1.92	.058
Final	Mother tongue lessons	1.35	.17	.03	.94	.33	.05	7.03	.000
Initial	Nature study lessons	.68	.29	.04	.51	.26	.04	3.13	.002
Final	Nature study lessons	1.57	.56	.09	.76	.27	.04	8.32	.000

Note: SE = Standard Error

Table 2. Differences between experimental and control group in class enjoyment and belongingness to group

Variable	Experimental (E) group			Control (C) group			Difference *t*	Significance *p*
	M	SD	SE	M	SD	SE		
Class enjoyment - *Nature study*	4.20	.72	.11	4.05	.50	.08	1.11	.270
Class enjoyment– *Mother tongue*	4.39	.48	.08	4.05	.54	.08	3.03	.003
Belongingness to group of school friends	3.34	.88	.14	3.51	.79	.12	–.90	.370
Belongingness to group of outside-school friends	2.87	.86	.15	3.00	.98	.15	–.62	.535

Note: SE = Standard Error

There are schools in the world that take into account life satisfaction, students well-being and class enjoyment when designing parameters with which to assess school's efficiency. Such is the case with some Israeli schools which offer their adolescents to attend specialized school classes [36]. It is hard to envisage the *SRI* model without student's involvement, which in effect yields their positive reactions. Enjoyment is closely related to student's desire for exploration and self-improvement, which are essential components of motivation [37,38].

Table 2 gives data pertaining to belongingness to group of school friends and belongingness to group of outside-school friends. There was no recorded difference between (E) and (C) group (t = –.90 for belongingness to group of school friends, and t = –.62 for belongingness to group of outside-school friends). Future work is needed to examine whether the longer periods of time devoted to *SRI* model of learning could potentially result in higher levels of belongingness to group of school friends. This also calls for research that would apply a longitudinal experimental design.

The third argument in the primary hypothesis had been that the application of *SRI* model of learning would reduce students' negative (aversive) emotions in classroom. Table 3 proves this contention, but with statistical significance present only in mother tongue (language) lessons (dissatisfaction: t = 2.00; significant at .05 level; anxiety: t = 2.40; significant at .019 level; Table 3, bolded lines). Reduction of negative emotions was recorded even during nature study lessons but with no statistical significance (Tale 3). We can assume that the longer utilization of *SRI* may result in reduction of negative emotions in nature study lessons, or even in other school subject classes.

The fourth argument of the first hypothesis was that students would be able to master *SRI* model of learning. Since *SRI* model was applied only among (E) group students, the statistical processing of data refers only to half of the entire sample. There are two pieces of evidence to support the fourth argument. First, *SRI* model is more efficient than traditional-style learning (t = 18.03; significant at .001 level). Second, group work, i.e. group interaction, is more efficient in application of *SRI* than individual work. To support this claim, we compared questions that originated as the result of group to those that came from student's individual effort. Group interaction results obtained significant difference in that respect (t = 47.16; significant at .001 level). A few things come to our notice here. First,by working in groups students exchange and elaborate ideas, perform critical thinking and adjust their explanations so they can be easily understood by their peers; this is where Vygotski's zone of proximal development (ZPD) comes to our mind [39]. Second, if classroom enjoyment is to be accomplished, students need to achieve self-control and experience social support from their peers [32]. Third, when they work interactively, students exhibit higher level of positive emotions [40]. In summary, these results are consistent with the findings of Gordon Brown and Nick Cater [41]. Their research has shown that the mapping, text representation and structuring of the text resulting effective learning.

3.2 The Second Experiment

The same sample of students constituted the second experiment; however the focus of the experiment was placed on the lesson itself rather than on the participating students. Total of 36 lessons was observed, 9 lessons per each of 4 different school classes. The observation was performed by six observers, experts who used *Efx* instrument for that purpose. The lessons were also attended by class teachers. The main hypothesis was that lessons with applied *SRI* model, either with pair work or group interaction, would be more efficient in terms of learning outcomes than traditional lessons.

3.2.1 Method

The basic method of this study was the observation. The method of classroom activity observation was based on visible manifestations of teacher and student behavior [42]. As visible manifestations of teacher and student behavior, the following two things were taken into account – direction of classroom communication, and engagement of students. Direction of classroom communication can easily be observed as it is seen as teacher/class (TC) communication, teacher/ student (TS) communication, student/ student (SS) communication, student/class (SC) communication, or even student/teaching material (STM) communication. These five types of communication cover almost all communi-cation directions, which made observation rather easy in terms of measuring how long each communication type lasted. Students' performance was recorded on Likert-type scale ranging from 1 = *not active* to 5 = *active and cooperative.* The observation was performed by means of *Efx* instrument, which was standardized and calibrated in previous research.

3.2.2 Procedure

Students and teachers were split into experimental (E) and control (C) group, and their performance was observed during 36 lessons. The observers were seated in the back rows so they could not divert students' attention. It was noted that in ten minute's time, students paid no attention to the observers and behaved as they normally did during lessons. At least two observers were assigned to each activity performed by teacher and students. *Efx* instrument is designed to observe direction of communication and teacher's activity, as well as to record any changes in the nature of teaching methods – frontal lecturing, individual work, pair work, or group interaction. The recorded similarities and differences among observers were first compared, and then, the emphasis was put on the direction of communication and type of teaching method applied in traditional teaching and *SRI* model of teaching. All the obtained date were coded and entered into SPSS 20 (Statistica for Windows) software. The variables were properly processed and the report on research results followed soon after. The experiment lasted 9 weeks.

3.2.3 Instruments

Only one instrument was used in this experiment, namely *Efx* (Efficiency of lesson) [43]. This instrument was intended to register the following: direction of classroom communication, student's and teacher's activity, and type of teaching method applied during class. Since this instrument is in the form of a detailed scientific protocol, the potential errors are reduced to minimum. For instance, if an observer monitors direction of communication, he/she only needs to record it by choosing the proper one out of the

five types of communication (TC, TS, SS, SC, STM). The total duration for each of the type was also recorded. Students' and teacher's activity was measured by means of five-point Likert scale.The lowest point for students is scored for their disengagement from lesson, whereas the highest point is given foractive work or cooperation. The same applies for the teachers: being negative or not interacting with their students is seen as the lowest point on the scale, whereas teacher's readiness to cooperate, facilitate interaction and enable students to adopt *SRI* model is seen as the highest point on the scale. The observation protocol was designed to have separate space for data recording in case teaching style method should change.The objectivity of *Efx* was tested by correlating different observations during the same lesson. Pearson Correlation was at a respectable level; p = .988 (t = 7.06: significant at .001 level). The Spearman-Brown prediction formula was used to calculate reliability (p = .72; m = 5.96: significant at .001 level).

3.2.4 Results

In order to prove efficiency of *SRI* model of learning, the present research applied *Efx* instrument, which had been designed to measure direction of classroom communication, student involvement (engagement), and types of teaching method used in the course of lesson. Scientific caution urged us to have two independent observers recording class activity by using the same instrument.

Table 4 provides results recorded as 72 lesson assessments (36 lessons x 2 observers), and they indicate that there is no statistical difference between the observers regardless of the type of teaching method applied.

However, the focus here was on the efficiency of *SRI* model of learning. Table 5 gives results that demonstrate *SRI's* efficiency over traditional teaching no matter which type of teaching had been applied. As summarized in Table 5, *SRI* stood above traditional-type teaching even if the applied method had been frontal lecturing (Table 1, row 1).

The reason lies in the fact that *SRI* model fosters student's cognitive engagement. For example, during the first step of *SRI* type reading, while the teacher was reading paragraphs of written material, he got interrupted by a student who wanted to hear it once again. This clearly speaks of the level of student's attention and concentration during *SRI* lesson. This shows that the involvement of students a powerful source of motivation in the classroom [33,34,35]. Although the class presentation was in the form of frontal lecture (reading), the students displayed substantial level of concentration because of the fact that their task had been to come up with a question for each idea presented in the form of paragraph. This example accounts for the high value of efficiency assessment within the (E) group students during frontal lecturing. To be able to make questions relating to the content presented by their teachers, students need to be engaged into the process of thinking, i.e. they have to develop a meaningful structure of ideas. Such model of learning is much more efficient than reproductive learning [19].

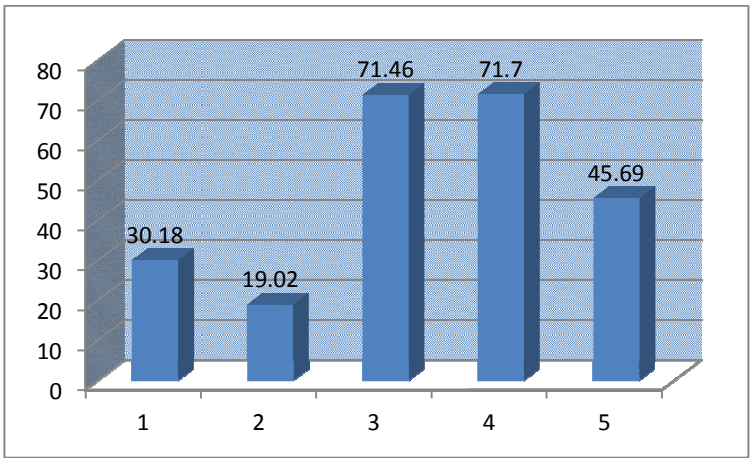

Fig. 1. SRI efficiency model in different types of teaching

1 = Front work; 2 = Individual work; 3 = Work in pairs; 4 = Group work; 5 = Average efficiency; The ordinate indicates the level of efficiency classes

Table 3. Differences between experimental and control group in initial and final measurements of emotions

Measurement	School subject emotion	Experimental (E)			Control (C)			Difference *t*	Significance *p*
		M	***SD***	***SE***	***M***	***SD***	***SE***		
Initial	MT/happiness	75.61	29.07	4.54	74.88	30.99	4.84	.11	.912
	MT/dissatisfaction	8.05	12.49	1.95	16.59	32.06	5.01	–1.59	.116
	MT/joy	77.07	30.43	4.75	70.61	36.85	5.75	.87	.389
	MT/anxiety	16.10	20,84	3,25	17,56	31,92	4,99	–.25	.806
Final	MT/happiness	73.41	34.25	5.35	81.70	26.44	4.13	–1.23	.223
	MT/dissatisfaction	**8.78**	**23.90**	**3.73**	**1.22**	**4.00**	**.62**	**2.00**	**.049**
	MT/joy	75.12	30.26	4.73	78.78	32.57	5.09	.53	.600
	MT/anxiety	**13.17**	**28.41**	**4.44**	**1.95**	**9.54**	**1.49**	**2.40**	**.019**
Initial	NS/happiness	71.22	33.92	5.30	77.81	31.42	4.91	–.91	.365
	NS/dissatisfaction	7.37	17.59	2.75	10.98	28.27	4.42	–.69	.490
	NS/joy	67.56	38.52	6.05	78.05	31.72	4.95	–1.34	.183
	NS/anxiety	8.30	20.60	3.22	9.02	22.78	3.56	–.15	.879
Final	NS/happiness	82.20	32.52	5.08	77.32	30.33	4.74	.70	.484
	NS/dissatisfaction	5.61	21.80	3.41	4.15	8.65	1.35	.40	.691
	NS/joy	81.46	32.45	5.07	76,68	31,03	4.85	.68	.497
	NS/anxiety	2.20	7.25	1.13	1.46	4.78	.75	,54	.591

Note: MT = Mother tongue; NS = Nature study; SE = Standard Error; Arithmetic means represent measures obtained from Thermometer of emotions: from 0 (freezing point) to 100 (boiling point)

Table 4. Lesson efficiency assessment (as recorded by different observers)

Type of teaching method	Pair of observers						ES	Difference t	Significance *p*
	M	SD	SE	M	SD	SE			
Frontal lecturing	29.44	19.40	3.60	30.88	20.21	3.75	1.44	–.28	.783
Individual work	20.31	12.15	4.05	17.08	5.44	2.22	3.23	.61	.555
Pair work	72.98	24.02	6.42	69.49	24.31	6.50	3.04	.33	.742
Interactive work	70.29	26.37	5.50	73.10	26.92	5.61	2.82	–.36	.722
Efx	44.56	26.54	4.42	46.81	28.19	4.70	2.24	–.35	.729

Note: SE = Standard Error; ES = Effect Size

Table 5. Lesson efficiency assessment –experimental (E) group (SRI) model, and control (C) group (frontal lecturing)

Type of teaching method	(E) group			(C) group			ES	Difference *t*	Significance *p*
	M	SD	SE	M	SD	SE			
Frontal lecturing	45.65	17.39	3.29	15.71	5.45	0.99	29.94	8.98	.000
Individual work	50.00	5.10	1.37	16.81	5.46	1.00	33.19	6.28	.000
Pair work	82.58	18.25	4.08	43.65	6.04	2.14	38.94	5.85	.000
Interactive work	82.49	18.07	3.01	32.82	8.18	2.59	49.68	8.41	.000
Efx	70.24	14.24	2.37	21.13	7.64	1.27	49.11	18.24	.000

Note: SE = Standard Error; ES = Effect Size

If questions arose from cooperation with other students or from group interaction, students displayed more efficiency than they did when frontal lecturing was applied (t = 8.41; significant at .001 level). This is concurrent with Lev Vygotsky's zone of proximal development (ZPD) [38]. Moreover, it is not only that students work in interaction with their teacher and peers, but they also demonstrate skills in argument presentation and negotiation during *SRI* model of learning. The *SRI* model of learning proves its efficiency with *Efx* values for (E) and (C) group, there is a statistically significant difference between the two groups (t = 18.24; significant at .001 level). By observing how they negotiate and fine-tune the ideas with their peers, it was easy to sense the way students carve their thoughts into concrete questions, and how proud they become of the fact that they managed to separate the most relevant content. The most important finding of this experiment is that group interaction is more efficient in *SRI* utilization than individual work.

4. GENERAL DISCUSSION

The present paper, with its two experiments, has clearly shown that *SRI* model of learning results in: (1) better retention (memorization) of teaching material, (2) increased level of student enjoyment, (3) reduction of negative emotions during lesson, (4) mastery at *SRI,* and (5) higher level of efficiency during lessons, or higher level of students' engagement. In the first experiment, students were tested by means of four instruments, and statistical significance was observed during lessons of mother tongue (content memorization) (t = 7.03; significant at .001 level) and nature study lessons (t = 8.03; significant at .001 level), enjoyment during mother tongue lessons (t = 3.03; significant at .01 level), reduction of negative emotions (dissatisfaction, t = 2.00; significant at .05 level; anxiety, t = 2.40; significant at .05 level). The tested sample of students provided findings supporting the notion that *SRI* model is more efficient than traditional-style teaching (t = 18.03; significant at .001 level). The second experiment findings speak in favor of the same efficiency. Namely, teachers and observers found that *SRI* is more efficient than traditional teaching (t = 8.41; significant at .001 level). A particularly interesting finding is that group interaction is significantly more efficient than individual work (t = 47.16; significant at .001 level). To conclude, the present paper gives a set of parameters which support the notion that *SRI* model of learning is more efficient than traditional learning during lessons of *mother tongue* and *nature study* among fifth-grade elementary school students.

When students learn with understanding, i.e. structurally, or when they rely on procedural and conceptual knowledge, they learn deeper and memorize things better [4]. *SRI* model is based around understanding the content of the teaching material, self-explanation and text processing. More concretely, understanding the written material comes before asking questions about it. When students highlight the main question, and separate the other relevant ones, they make a structure based on ideas and concepts expressed in the text, and automatically perform evaluation, which is higher-order category in Bloom's Taxonomy [31]. These are all elements of *SRI* model, which has been found applicable in learning among fifth-grade students, aged 11 to 12.

5. LIMITATIONS

Of course, there are certain limitations in this research. First, the efficiency of *SRI* model was tested on mother tongue and nature study lessons, but it did not include lessons from subjects like math and physics.The future research should focus more on math and natural science classes, such as physics, biology, chemistry, etc. That should not be difficult as we have provided simple instruments and methodology in our research. Second, it took students nine 45-minute long classes to master *SRI*model to a certain extent; in order for them to acquire complete mastery of *SRI* model, it would take them about 18 to 20 classes of work.Third, the study design here was cross-sectional, but it would be interesting to observe effects of *SRI* model on efficiency of content memorization, class enjoyment, etc., over a period of time, for example after the summer break. Fourth, the influence of *SRI* model on writing performance has not been tested in this study; however, we dare to surmise that it would have positive effects on writing skills as well.

6. CONCLUSION

The main objective of the present research wastwofold: (1) to show that elementary school students (11 to 12 years of age) can accomplish mastery of *SRI* model of learning, and (2) to prove the efficiency of the model. Both objectives have been completely validated in our research. Reproducibility, as one of the main principles of

the scientific method, is the ability of the study to be duplicated. The uncomplicated methodology used in this study, has ensured the reproducibility of the research in case any advanced student of pedagogy, psychology, or sociology should want to replicate the experiments, either to confirm or to reject our findings.

To provethe efficiency of *SRI* model of learning (Separate Relevant from Irrelevant), the present paper has provided two studies conducted on fifth-grade elementary school students. The participants were students, aged 11 to 12, from four elementary school classes of two Banja Luka elementary schools; they were divided into experimental (E) group (41 students), and control (C) group (41 students). The (E) group students utilized *SRI* model, and their performance was recorded in order to obtain statistical indicators of *SRI* model of learning efficiency. The second study dealt with the class performance observed during mother tongue and nature study classes; 36 lessons were taught by means of *SRI* model (*E group),* and another set of 36 lessons (9 lessons in 4 classes) taught in traditional style. Each lesson was monitored by two independent observers. The study was carried out on the same sample of students.

Research findings show that *SRI* model of learning is more efficient than traditional-style classes in the following respects: (a) retention (memorization) of the learning content, (b) student's class enjoyment, (c) reduction of negative emotions during classes, (d) mastery of *SRI* modelat the age of 11 to 12, (e) efficiency of teaching and student engagement during lessons.

The present paper also provides directions for reproducibility of its findings, and suggests a couple of possible avenues for future research.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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