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STEM Revisited: A Paradigm Shift in Teaching and Learning the Science Related Disciplines

4

ABSTRACT

5 For an appropriate way to deal with teaching and learning the Science Related Disciplines there is an
6 axiomatic need to accept an integrated-holistic approach both in terms of the way we regard them and of
7 how we practice them. As a result of that need, this paper presents a multi-prong proposition to
8 substantiate that teaching and learning of the SRD have recently undergone a paradigm shift from a
9 Relational Literacies approach, based on searching for knowledge, and which in turn has replaced the
10 traditional Independent Disciplines approach, based on transmitting knowledge, towards an integrated-
11 holistic approach, bringing education into the new Integrated Competences paradigm, which is based on
12 formulating knowledge and which should be understood as representing the confrontation of the Science
13 Related Disciplines with the real world and its conditions.

14 *Key Words: Paradigm shift, Integration, Classroom knowledge, Science Related Disciplines.*

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16

1. INTRODUCTION

17 A basic principle of epistemology is that the way scientists are approaching and practicing their disciplines
18 is limited almost exclusively by their "myths". Any judgments scientists are making are based on their
19 myths and are revealed in their minds as reflections of the objective reality [1]. Thus, a major concern in
20 any scientific endeavour, including the approach to teaching and learning the *science related disciplines* (a
21 broader than STEM term to connote the accepted natural/positive science disciplines of Mathematics,
22 Physics, Chemistry, Biology, Computer Science, Astronomy, etc.) is the source of their myths. Science
23 educators invariably accept the notion that science related disciplines (SLD) should satisfy certain
24 functional conditions that qualify their nature and require systematic ways in order to satisfy basic
25 methodological needs. As a result, it should be clear that if we are to establish the right approach in
26 considering teaching and learning the SLD, it is necessary to face the reality of their myths, which in turn
27 constitutes an inseparable part of our envisagement of these disciplines as well as of our methods we use
28 in applying them in education. The question that we need to ask in the current academic, technologic and
29 socioeconomic environment is: what are the "myths" with which we have to approach the SLD in
30 education?

31

32 Unambiguously and categorically, I would like to declare that at the centre of the approach towards
33 teaching and learning the SLD, should be the concept of a holistic approach or of an integrated
34 education. I suggest that this concept constitutes the source of the SRD myths not only in terms of the
35 way these disciplines are regarded in education, but also with respect to the methods used in applying
36 them in teaching and learning. This inevitably leads to the position that the present approach to teaching
37 and learning the SLD, as expressed by the STEAM or STREAM concepts, which have replaced the
38 original STEM concept, is now absolute and we find ourselves in a period where the science related
39 disciplines are regarded and applied within an integrated education framework.

40
41 This holistic approach might be considered incompatible with the current practices in teaching and
42 learning the SLD. But necessary educational processes such as: openness, sharing, interpersonal
43 relationships, discourse, personal motivation, tacit over explicit knowledge, as well as the sharing and
44 reusability of learning resources on the web cannot be addressed in the traditional (i.e. the STEM
45 approach) or the present (i.e. the STEAM or STREAM approaches) educational practices. Nowadays for
46 an appropriate way to deal with teaching and learning the SRD there is an axiomatic need to accept a
47 new approach both in terms of the way we regard these disciplines in education and of how we practice
48 their teaching and learning. However, this integrated-holistic approach should be understood as starting
49 with an educational science confrontation and out of that phenomenological confrontation comes a
50 question related to the teaching of the SRD, one which is too broad to be answered by any single
51 discipline or by the independent contributions of many disciplines.

52
53 This is particularly evident in the STEM type approaches where the educators pay lip services to skill sets
54 such as: integrate content, interpret and communicate information, engage in logical reasoning,
55 collaborate as a team etc. [2]. But applying such standards of practice is impossible within the
56 epistemological framework they operate, since their approach by focusing on the nature of knowledge
57 and how students learn, relies at best on a student-centered approach. However, such skills invariably
58 require multidimensional relationships and interdependencies of the participating disciplines,
59 necessitating an integrated educational process, which exceeds the capabilities of the student-centered
60 paradigm.

61 Finally, the rationale provided for supporting STEM type approaches usually take a purely utilitarian form
62 [3] such as *“...STEM occupations are growing at 17%, while other occupations are growing at 9.8%,
63 ...STEM degree holders have a higher income even in non-STEM careers, ... science, technology,
64 engineering and mathematics workers play a key role in the sustained growth and stability of the U.S.
65 economy”*. [4]. Yet the presence of the SRD in education is necessitated mainly for providing an
66 interdisciplinary approach, which rather than teach disciplines as separate and discrete subjects,
67 integrates them into a cohesive-holistic learning paradigm, which represents their major educational
68 contribution [5]. In other words, the SRD provision of knowledge is as valuable and their contribution is as
69 important as any other discipline and not the determining factor in supporting their utilization.

70 From this brief introduction it should be evident that there is a need to connect education and SRD as to
71 how we regard and practice classroom teaching and learning, towards achieving an integrated-holistic
72 educational system. This objective represents the focus of this paper and is examined in the form of the
73 following proposition.

74 75 **2. THE PROPOSITION**

76
77 The proposed new approach towards the SRD represents a multi-prong proposition expressed as follows:
78 first, education constitutes a dialectic entity, part of which are the SRD; second education in general and
79 the teaching and learning of the SLD in particular, are following a new educational paradigm; third the
80 determining factor in the SRD changes observed are the result of the shifts in societal perceptions and
81 beliefs; fourth the education paradigm shifts have been catalytic in altering the way knowledge is
82 approached in the classroom; and fifth a constant and well defined principle has underlined all the
83 observed changes. The proposition, as outlined, clearly indicate that in order to understand the role, the
84 value and the impact the SRD have in education, it is imperative that we examine all these aspects:

85

86 The first aspect of the proposition is concomitant with the prevalent educational need that today's
87 educational disciplines and especially those related to science, should provide combined, simultaneous
88 and not fragmented competences, which cannot be dealt with unless we accept the fact that they
89 represent different manifestations of "a whole", the **dialectic entity** of education, to which the SRD
90 belong. Therefore, a holistic approach towards teaching and learning is imperative to address present
91 and future conditions, where such disciplines represent a pivotal component.

92 The second aspect implies that a stepwise process of changes in teaching and learning the SRD has
93 taken place, which was determined by the way **education was considered and applied** over time and
94 which in turn was the result of the societal changes that took place. In other words, societal changes of
95 the last few decades have been the determining factor in shaping the responses in considering and
96 applying education and the SRD, which in turn led to educational changes that epistemologist Thomas
97 Khun [6] has termed paradigm shifts. It should be noted that changing paradigms are not rare or
98 unexpected events in education [7].

99 The third aspect suggests that the driving forces in the observed changes towards SRD are the result of
100 the shifts in societal perceptions and beliefs. Indeed, it is universally accepted and well documented that
101 societal values and goals are changing through time resulting in profound changes in all aspects of our
102 lives, including the way teaching and learning is approached [8]. [9]. Following World War II and for many
103 years, education, including SRD, had a **limited value** for society. Education was systematically
104 downgraded and considered as just a tool in attaining other pressing societal objectives. It was only in the
105 1970's that the significance of education and especially of the SRD was recognized and the requirements
106 of teaching and learning acquired a place at **the center** of societal interests. Finally, in the last few
107 decades society realized that the world that surrounds us is simultaneously ecological, economic, social,
108 technical/technological, political, cultural etc., in dialectic harmony with all aspects of the environment
109 (natural and man-made), an integral part of which are the people and consequently their education. As a
110 result, the new societal concerns have moved societal responses in dealing with educational problems
111 and challenges, including SRD, towards a **holistic** approach.

112 The fourth aspect is concerned with the changes in the way knowledge in the classroom is treated and is
113 based on the fact that epistemological arguments concerning education by necessity relate to knowledge.
114 More specifically, dealing with classroom knowledge has changed from a mechanist way of simply
115 **transmitting** knowledge contained within individual **disciplines** (i.e., the teacher instructs how water
116 evaporates in physics and in chemistry that water is one of the physical elements), to **searching** for
117 knowledge by creating **literacies** out of related disciplines (i.e. students in order to be familiar with
118 phenomena and processes in physics, the necessary literacy, they have to be also familiar with certain
119 mathematical principles), to finally **formulating** knowledge by instituting **competences**, which have to
120 include cultural, technical/technological, social, political etc. aspects as well as motivation, skills etc. The
121 last approach is possible through the integration of all possible disciplines (i.e. the literacy related to any
122 of the SRD or the ability to learn them is important, but learning how to learn them or have the
123 competence for these disciplines is more fundamental).

124 The fifth aspect is related to the fact that in the last few decades although change was the driving mode in
125 society and all of its expressions, at the same time a constant principal has been the determining force.
126 More specifically, changes in society and the resultant adjustments in considering and applying education
127 as well as teaching and learning SRD have been following the same sequence in their evolution through
128 time. The **independentance** of the core factors/ disciplines was replaced by their **interaction**, which in
129 turn was substituted by their **union**. For example, the independent teaching of well-defined disciplines
130 was later replaced by their interaction producing relations, interdependences and interactions in the form

131 of needed literacies, which finally were readjusted as their union, producing an educational entity in the
132 form of specific competences (Fig. 1).

133

FIGURE 1

134 3. CONSIDERING EDUCATION AND SCIENCE RELATED DISCIPLINES

135

136 The way we view teaching and learning of the science related disciplines by necessity follow changes in
137 the way education is considered, which in turn are based on the way we reconstruct societal values and
138 consider important societal goals. Every time a political, environmental, technological and in general a
139 societal change is happening a new educational approach is needed to educate students for the existing
140 and future conditions. However, every time an educational change is happening a new approach is
141 required to educate students for the pivotal and challenging science related disciplines. This implies that
142 over time a stepwise process of changes is formulated to respond to societal, educational and SRD
143 adjustments. In considering education and the SRD, the following three approaches were in operation
144 (Fig. 2 left columns).

145

146

FIGURE 2

147

148 3.1 The Traditional approach

149

150 In the first period, the minimal societal concern for education led into accepting education as a way of
151 teaching and learning the "what" and not the "how" [12], using the least controversial approach, whereby
152 teachers and children were busy covering what was set forth in the textbooks and workbooks. In addition,
153 because society and other scientist had little or no interest in education, teaching and learning was the
154 exclusive realm of educators who were the only ones that could offer the methods, techniques and
155 knowledge to handle education. Under this perspective, every particular discipline would be concerned
156 with its own subject area and its practitioners consider them in an exclusive manner, creating a
157 **monodisciplinary** approach to education.

158

159 At the same time, the minimal societal attention to education and the monodisciplinary educational
160 approach provided the rationale to consider SRD in a fragmented way, despite the lip service provided by
161 the STEM proponents to the need for these disciplines to be "brought together to make proliferating
162 their importance easier" [13]. In other words, the science aspect of education was represented
163 individually by the separate subject matters of the disciplines related to science, technology, engineering
164 and mathematics, which were considered as the only ones that could offer the methods, techniques and
165 knowledge to handle such specific science dimensions. In this monodisciplinary approach science was
166 faced by specialized teachers through their "exclusive" independent disciplinaries, creating a **fragmented**
167 science education. For example, there was a distinct and clear differentiation between physics and
168 chemistry, which were considered as two distinct subjects to be taught by teachers from different
169 disciplines. At the same time mathematics were considered as providing the tools in teaching these
170 disciplines and not a necessary component in understanding them and shaping their role in
171 formulating the entity of education.

172

173 3.2 The Existing Approach

174

175 In the 1970's, the second period, there was a strong questioning of the monodisciplinary and the
176 fragmented approaches the educational community was following, resulting in the development of

177 alternative ways in considering them. That challenge has been eloquently presented by Newell who wrote
178 that “*An academic*
179 *discipline is a challenging intellectual game at best, and a sterile and meaningless exercise at worst,*
180 *when it is taken out of the context of human experience, which is always too broad and complex to be*
181 *captured fully by any one discipline*” [11]. More specifically, all teaching and learning needs were
182 considered as requiring to be approached from various perspectives and concerns [14], [15]. Education
183 was treated as if it consisted of the sum of all the distinct parts of a multidimensional cultural, political,
184 social, environmental and economic reality that led to a **multidisciplinary** approach towards education.

185
186 At the same time, the increase of the societal attention and the multidisciplinary approach to education,
187 provided the basis for an alternative consideration of the SRD. An approach based on the notion that
188 human knowledge necessitates “abstractions” of all aspects of reality and thus learning has to be
189 expressed in the form of a set of **separate relations**, interdependences and interactions, especially in the
190 SRD, where such an approach is absolutely feasible and extremely easy to apply. In the previous
191 example, Physics, Chemistry and Mathematics all could and were participating on equal footing in the
192 education process, but by providing their individual contribution in a set of separate and distinct
193 approaches.

194

195 **3.3 The New Approach**

196
197 In the last few decades, the third period, society by accepting that our world has to be approached as a
198 dialectic entity, has realized that today’s multidisciplinary approach to education and the existence of
199 separate approaches of the disciplines related to science cannot be acceptable anymore. A different
200 teaching and learning approach are required in order to express the multidimensional relationships and
201 interdependencies of all the disciplines that participate in the education process, which is the “whole”. As
202 a result, an **interdisciplinary** approach is required towards education. An integrated approach that has to
203 be simultaneously cultural, technical/technological, social, political etc., in dialectic harmony and
204 respecting all aspects of teaching and learning an integral part of which are all disciplines and all
205 education stakeholders.

206
207 In terms of the SRD at this period, the societal acceptance of the need to consider our world in a dialectic
208 manner and the interdisciplinary approach to education, have led towards an **integrated** approach. This
209 approach expresses the integration of all possible disciplines and their learning actors and processes in
210 order to overcome the compartmentalization of knowledge, which presently is unacceptable. That is,
211 there are no distinct boundaries between Physics and Chemistry, in the same way that we cannot
212 determine where Science stops and Technology starts. In addition, no discipline can be considered as not
213 belonging or have the ability to contribute to SRD. For example, in STEM the case was made to add the
214 Arts and lately Reading and Writing, while Linder has written that “Geography is STEM!” [16]. That is,
215 SRD should be considered as encompassing all disciplines, as none of the disciplines alone would offer a
216 responsive to present needs approach, without contributions from other disciplines.

217

218 **4. PRACTICING EDUCATION AND SCIENCE RELATED DISCIPLINES**

219
220 The way educational tools are utilized in teaching and learning depend on the attitudes and the way
221 society regards education. That is, changes in societal values and goals lead into changes in the way we
222 practice and reinforce newly developed pedagogical concepts. Moreover, every time a societal change is
223 taking place and a new educational practice is formulated, a new methodological adjustment in teaching
224 and learning the SRD is required in order to properly educate students in these fundamental disciplines,

225 whose importance keeps increasing. This implies that over three time periods a distinct process of
226 changes has taken place in the way the SRD have alter their application mode in response to societal
227 shifts and educational adjustments. In terms of the way we have apply education and the SRD, the
228 following three approaches were the most profound (Fig. 2 right columns).
229

230 **4.1 The Traditional Instructional Approach**

231
232 In the first period, the use of tools utilized in teaching and learning depend on the attitudes and mind set
233 of the education stakeholders and the way they practice education, which in turn represent their
234 adjustment to societal changes. In the traditional instruction approach the basic societal tenant of
235 education as socially non-important activity resulted in a very simple classroom instruction mode: the
236 teacher, the only responsible for educating students, transmits information to them who passively listen
237 and acquire facts. Pedagogically, in this approach the subject matter and teaching methods are based on
238 a well-defined instruction-based curriculum. This has led to the well-known and long-lasting traditional
239 **Teacher-Centered Instructing**, which was focused on the simple transmission of a well-defined
240 discipline's subject matter.
241

242 During the same period teaching and learning of the SRD was also a curriculum approach based on the
243 idea of educating students in specific SRD disciplines (i.e. the focus of STEM was to improve the
244 teaching of four specific disciplines: Science, Technology, Engineering and Mathematics). Every SRD
245 discipline through its "exclusive" subject matter has been providing a fragmented and descriptive learning
246 process (the way students can learn SRD), which was facilitated by the **traditional instructional**
247 approach.
248

249 **4.2 The Present Instructional Approach**

250 In the 70's, the second period, the educational community had strongly questioned the Teacher-Centred
251 Instructing and the discrete discipline approach to education, resulting in the development of alternative
252 ways in formulating them. Following the changes in societal goals and the way classroom education was
253 approached there was an intense push towards creating engaging learning environments that provide
254 students with meaningful learning experiences from various forms of learning relationships, which are the
255 result of discipline interactions. Under this perspective, education was treated as if it consisted of the sum
256 of all the distinct combination of disciplines expressing the multidimensional reality. This corresponds to a
257 **Student-Centered Learning** education which involves not only learning (practices, motivation,
258 achievements etc.) but also the learner (backgrounds, talents, interests, capacities, and needs, etc.).

259 In terms of the SRD, in the second period the societal changes and the alternative to the traditional
260 educational classroom approaches, led towards a new form of teaching and learning. This new approach
261 was based on the fact that knowledge of the SRD necessitates "abstractions" of various aspects of other
262 disciplines and thus learning has to be expressed in the form of a set of relations, interdependences and
263 interactions between disciplines. In addition, the present SRD instruction approach by emphasizing the
264 importance of interrelationships and interactions in fostering learning resources, requires the creation of
265 participatory learning experiences. In other words, it is based on **Constructivism** [17], or how students
266 learn to construct their own understanding and knowledge of the world and not on Constructionism [18],
267 the theory that learners construct mental models to understand the world around them, which raises
268 several questions and whose discussion is beyond the subject of this paper.

269 **4.3 The New Instructional Approach**

270

271 In the previous periods, the disciplines involved in the instructional approach were considered by the
272 education community as independent and sometimes conflicting pedagogical forces. However, the
273 literature and experience show that such an approach is clearly scientifically shallow, logically unsound
274 and mainly lacking the necessary integration required in the complicated and dialectic present day
275 scientific, societal and educational environment [11]. That is, mathematics is a necessity in transferring
276 knowledge in physics, in the same way that teaching and learning physics cannot ignore subjects such as
277 reading and writing [19]. By accepting such an instructional approach, where all subject matters are
278 integrated and available to all students provide the instructional tools that can address the distinct
279 learning needs, interests, aspirations, or cultural backgrounds of individual students or simply provide
280 **personalized** instruction. In addition, what separates the new instructional approach from the presently
281 used one, is the **blended** learning environment it can provide, which shows students how scientific
282 methods can be applied to everyday life, by enabling them to confront the world through interrelations and
283 interdependencies in the form of competences [20].

284 In terms of the SRD, in the third period, serious questions have been raised regarding the presently used
285 instruction approach. Science educational stakeholders have finally begun to realize that the skills
286 required in SRD should include arts and crafts, reading and writing, visual thinking, modeling etc. as
287 access points for guiding student inquiry, dialogue, and critical thinking. It is evident that in SRD all
288 disciplines are teaching and learning factors in the pedagogical process. Because all disciplines, including
289 SRD, are closely interrelated, complementary and not conflicting they have to be integrated into a new
290 **holistic** instructing approach.

291 **4 PARADIGM SHIFTS**

292
293 These changes and their resultant implications are of paramount importance in understanding the
294 formulation of the paradigm shifts that have taken place during the last several decades. They basically
295 are addressing the way knowledge is transmitted in the classroom during three distinct time periods (Fig.
296 2). More specifically, in the first period, teaching and learning was focused on the transmission of
297 knowledge, determined by the chosen by the teacher specific discipline. In addition, the subject matter
298 studied was remote from the daily concerns and interests of the children, but instead it had to follow the
299 orthodoxy of the discipline's pedagogical concepts as they were set forth in the textbooks and the
300 curriculum. The result has been the formulation of the **Independent Disciplines** paradigm, whose main
301 SRD teaching tool has been the teachers' instruction (Fig. 2, first row).
302

303 During the second period, education was directed towards searching for knowledge by following a literacy
304 approach in the classroom. The use of the term literacy follows UNESCO's definition, which refers to
305 students' "ability to identify, understand, interpret, create, communicate and compute" [21], which are
306 associated with varying contexts or disciplines. The result has been the formulation of the **Relational**
307 **Literacies** paradigm, which utilizes the SRD to search for knowledge by focusing on both the individual
308 learners (their heredity, perspectives, backgrounds, talents, interests, capacities, and needs) and on
309 learning itself (the best available for all learners), in order to achieve literacies, which represents a step-
310 wise improvement over the traditional paradigm (Fig. 2, second row).

311 In the final period, teaching and learning is focused toward formulating knowledge by instituting
312 competences. Students are trained to construct their own knowledge of the world, by experiencing things
313 including their cultural, technical/technological, social, political etc. aspects and reflecting on them.
314 Moreover, students by questioning themselves and their strategies, become "experts" on their own
315 learning, providing them with the necessary tools in the classroom to keep learning or *learn how to learn*.

316 Such an approach is leading towards the new ***Integrated Competences*** paradigm. which in opposition to
317 the previous paradigms provides prescriptive and not descriptive learning or the way students should
318 learn. (Fig. 2, third row).

319 A new teaching and learning the SRD paradigm has emerged, which is based on the two pillars on how
320 learning is considered and is practiced and can be defined as the process in answering pedagogical
321 questions, solving teaching problems or addressing learning topics utilizing SRD and which cannot be
322 dealt with adequately by the traditional and the presently used educational paradigms. This new
323 Integrated Competences paradigm draws on various perspectives that express multidimensional relations
324 and interdependencies of the elements that constitute or represent specific aspects or parts of the SRD.
325 Because of the present day societal and educational needs and the nature of the SRD all aspects
326 reflecting on them have to be considered in order for integrations and not mechanistic sums to be
327 achieved. It is through the execution of a holistic approach, based on a new SRD perspective and in
328 dialectic harmony with the competences from various subjects that nowadays education has to be
329 approached. This necessity has been recognized for some time, but unfortunately educational inertia
330 cannot be easily overcome. For example, the Nobel laureate and physicist William D. Phillips in his
331 biography wrote "*I enjoyed and profited from well-taught science and math classes, but in retrospect, I*
332 *can see that the classes that emphasized language and writing skills were just as important for the*
333 *development of my scientific career as were science and math"* [22]. In sum, the competence paradigm
334 represents a one-way educational street in teaching and learning the SRD.

335

336 **5 CONCLUSIONS**

337

338 The starting point for this paper has been the recognition of the difficulty scientist trained in the 20th or the
339 21st century are having in understanding the account of the physical world in education, which has to take
340 into account the basic principles of the ancient Greek philosopher Aristotle [23]. In other words, we can no
341 longer look for precursors of modern ideas in teaching and learning without stressing the social and
342 philosophical character of education.

343

344 Within this framework the previous discussion clearly validates Ryan and Bauman claim that "*We are in a*
345 *time of emergence when the best advice is to observe and to be sensitive to areas from which change is*
346 *emerging.*" [24]. Indeed, in the relative recent past changes in societal values towards education (from
347 ignoring it, to bringing it at the center of societal priorities and to considering it as a dialectic entity) have
348 led to changes: first, on how we consider education (from monodisciplinary, to multidisciplinary and to
349 interdisciplinary) and SRD (from fragmented, to separate relations and to integrated); and second on how
350 we practice education (from teacher-centered, to student-centered and to personalized/blended learning)
351 and SRD (from disciplines, to literacies and to competences).

352 The new paradigm is characterized by its integrated nature, which is a quality that has generated many
353 scientific discussions. Arguments against any integrated approach rest on a conceptual confusion
354 expressed by professor Benson who has stated: "*integrated studies are a fool's project, propounding*
355 *equations where all terms are unknown*" [25]. However, the Integrated Competences paradigm as a
356 connection between integration, interdisciplinarity and personalized learning, should be understood as
357 representing the confrontation of the SRD with the real world, be it a pedagogical, a societal, a teaching,
358 a learning or any other issue. But out of this phenomenological confrontation rises a situation which is too
359 broad to be handled by a mono or a multidisciplinary approach as well as by a teacher-centred or
360 student-centred method, with no regard for the holistic nature of that world. That is, the purpose of the
361 Integrated Competences paradigm is more than just to address questions that transect discipline

362 boundaries or integrate subjects or methods in achieving teaching and learning. It involves an articulate
363 spectrum of principles to help the education system to determine when and how to confront the world by
364 seeking out a holistic approach to interrelations and interdependencies, that can be achieved with the use
365 of SRD in the form of their competences.

366 In sum, in the last few decades there have been two pedagogic shifts from the traditional **Independent**
367 **Disciplines** paradigm, to presently used **Relational Literacies** paradigm, bringing education to the
368 **Integrated Competences** paradigm, which is here to stay and followed by all, if we are going to educate
369 students for the complex and challenging present and future needs [26], [27].

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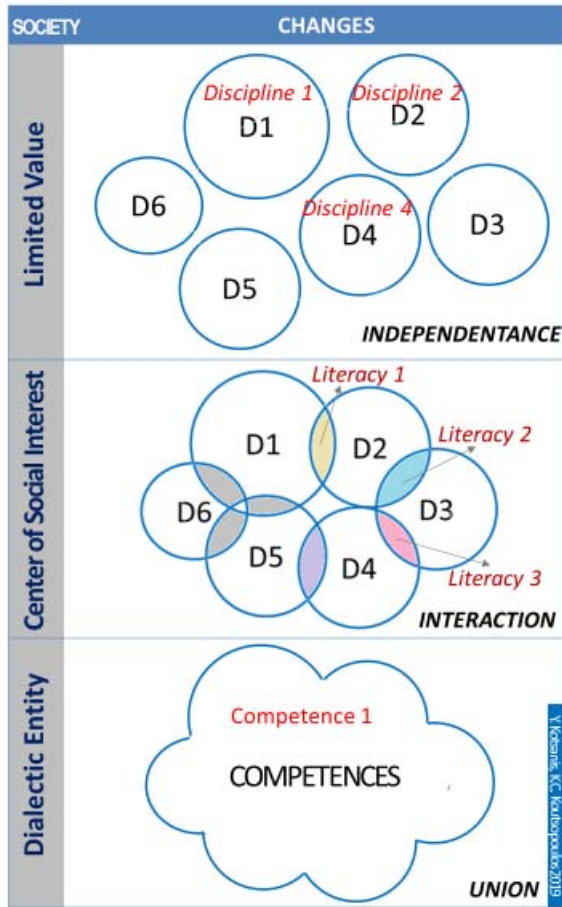
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Fig. 1. The Determining Principle of Change



484 Fig. 2. Changes in Society, Education and the SRD.
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UNDER PEER REVIEW