A Technical Method for Problem Solving in a Holistic Approach

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Abstract

In modern days, engaging brain is a challenging task. In a classroom setting, problem solving requires engagement of brain and utilization of intellectual abilities of the students. Throughout the world, different institutions and academy is trying to increase effective brain engagement in both organizational and academic purpose in order to accelerate productivity. This productivity is considered as learning outcomes in an academic setting. However, success is considered as a dependent variable of engaging human mind set in that particular situation. Additionally, introducing creativity and applicable strategies can be considered as the increasing factor of brain engagement in classroom environments. In this paper, we have presented a model based on the essence of the Gestalt Theory of learning for problem solving in a technology supported learning environment called Education Aid System (EAS). Our intention was to enhance engagement of the students in the classroom related to problem solving and creativity in a holistic approach. In addition, this technical model gives emphasis on joint intelligence of the students for solving problems. This model might ensure intellectual abilities, identify and overcome their difficulties for all the segments of a particular problem of the students and encourage them for working collaboratively on a given problem. The teacher's role in the EAS is to develop insight amongsts the students for solving problems.

Keywords— Gestalt Theory, Student Mind, Employability, Creativity, intellectual ability, Brain Engagement

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1 Introduction

Problem solving requires intellectual abilities of the students. In a face to face classroom situation especially in higher education, we give students several tasks/problems for finding solutions. Generally, emphasis is given on problem solving individually. However, students have lack of opportunity to involve in solving problems or teacher's task in an interactive manner with the fellow students. Classroom is a floor for learning fundamental and advance strategies, and acquiring skill set for applications in the practical field. Furthermore, it can provide an individual with necessary dimension for increasing thinking capability which is necessary for their future advancements. Gestalt theory of learning talks about problem solving in a holistic approach. Different educationalist, and scientist have tried to connect the Gestalt theory with education as the theory depicts several principles, such as, Law of proximity, Law of Similarity, Law of Closure, Law of Good Continuation, Law of Pragnanz and Law of Figure [1]. Furthermore, Gestalt theory can be directly applied as a substance of education for its tremendous mind mapping capability for problem solving. In learning, Gestalt theory suggests that, fill up knowledge gap by solving related problem with prior knowledge which helps to gain new insights. Moreover, relationship among the elements which creates the problem should be discovered [2]. According to the Gestalt theory of learning, one should perceive things as a whole rather than its parts for better insights.

Different theories of learning support use of computer technology. The main reason is: this technology helps students for knowledge construction in a collaborative manner. Computer mediated learing was found to be an important avenue for acquisition of knowledge and skills and improvement of interest of the students in learning [3] Group interactions through computer aided learning contribute to achieve higher academic grdeas and increase confidence level of the students [4], [5]. Within the scope of this study, we have proposed problem solving through a computerized system where students can get together in the system for a common interest of their learning.

In this paper, we figureout and present a model called Education Aid System (EAS) which is based on the essence of the Gestalt principles of learning for problem solving. The system offers students to reflect on the given problem individually and then collectively for development of insight for finding solutions to the problems in a face to face classroom environment.

2 Related Studies

Researchers throughout the world are experimenting different approaches for engaging student's brain in the class room activi-

ties in order to pull out the most creativity and intelligence. Researchers like Agustianto *et. al.*, Permanasari *et. al*., Kusumawardani *et. al.,* Hidayah *et. al.* used an adaptive learning (AL) process focusing on recommendation and inquiry based learning using Naïve Bayes Classifier (NBC) [3]. In their research, they have tried to develop a learning path (LP) based on the recommendation of adaptive learning process. Another research conducted by Wei-Lun Lin *et. al.* and Yunn-Wen Lien *et. al* [4], suggested a Dual-Process Theory for creative problem solving. Their research includes the processes which relates to creativity involved by both open ended and close ended creative problem solving [4] and these are both important depending on the individuals. They have also related the divergent thinking capability. A similar study conducted by Mumford, Hestler, Robeldo, Peterson, Day, Hougen and Barren *et. al.*, intended to build peoples mental model that finds the qualitative solutions for the critical and complex problems in the light of creative thought [5]. They have shown that creative problem solving is capable of reside in multiple domains in terms of the attributes of an individual's mental model [5]. Developing a mental model is very crucial factor for both intelligence and creativity in a working environment. That is why these two terms are often called the key terms for sustained employability. Regardless these two aspects, there are some other key factors like problem solving capability, ability to mind map, capability of relating things with prior knowledge do also have direct or indirect effects on learning activities. According to Regina O. Smith *et. al*., problem based learning, concept maps and the relating factors of learning element open the pathway to deep learning [6].

Researchers are also focusing on information systems which are capable of aiding both teachers and students. Takahiro Sato *et. al,.* in his research [7] have shown a Computer Management Information System which provides guidance of instructional decision making by the teacher by analyzing several data such as student response data.

The model we intended to develop is to engage students in segmented problem solving activities based on the class lecture. Later, difficulties of each segment shall be placed on to some sort of information system so that, the student can match their difficulties or gaps of each segment with their peer group. After getting new insights again they will be able to save their new insights gained by solving the problem and peer interactions. However, the instructor or facilitator in the class room can access all the difficulties which shall be stored as text form and learn (e.g., feedback, machine learning, alert etc) from the information system for deploying more creative and intellectual problems. In the essence of the Gestalt theory we shall describe our model in the Model Representation section.

3 TECHNICAL MODEL

Our model based on the essence of the Gestalt theory, has several components. The model has several components, such as, set up problem and environment**,** Individual Problem Solving Phase**,** Solution Phase, Interaction Phase**,** Gaining New Insights (Figure 1). Firstly, an information system which we named Education Aid System (EAS) is responsible for storing store all the problem data in respective accounts. Every problem might have one or many difficulties faced by the students. However, these difficulties can be saved in the EAS database by the students through logging in their own account. Furthermore, new insights can be gained through both solving problem and student interaction. Again, gained insights can be stored inside the EAS which can be used later for self development and other purposes such as creating problems with more points of inte est by teachers.

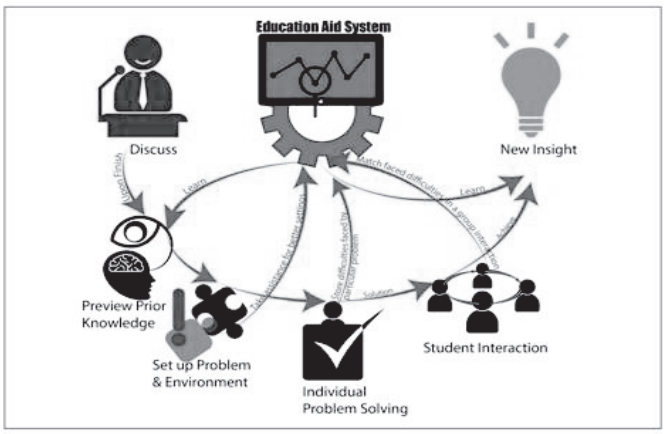

Figure 1: Technical Model of EAS

Secondly, a successful class can be conducted by discussing topic and relating with a reality. Successively, teacher shall setup problem and all the environment variables. Students will try to solve the given problems individually. While solving particular problem students are required to store their difficulties in the EAS for further assistance. Solution of the

particular given problem can be both provided by either teacher or the students depending on the problem structure. After getting the solution, peer group interaction shall be required. In this phase, students are able to match the difficulties with others through their EAS accounts while group interaction. By doing this activity students shall be able to identify the pattern of their weakness or knowledge gaps for a particular problem set. After learning through the EAS and the student interaction process, students are able to build new insights which will be based on prior knowledge.

3.1 Discussion of the topic

Teacher shall discuss topic before providing problem segments. The discussion topic can be in a singular or multiple forms depending on the class.

3.2 Setup problem and environment

Teacher can setup problem based on discussed the topic. Additionally, help from EAS can be achieved while setting up problem in several segments. For the purpose of setting problem one should always bear in mind that, engaging student brain is a function of intellectual ability, creativity and motivation. Also, brain engagement activity requires suitable environment setup and a feedback system for increasing of all factors mentioned above.

Let us consider Brain Engagement Activity as $B_{activity}$, Intellectual Ability as I_a, Creativity as C_r, Motivation as M_o, and environment as env. Then such equation can be considered as,

$$Br_{activity} = EngageBrain(I_a, C_r, M_o)_{env} + Feedback. \quad (1)$$

Feedback can be achieved by matching own difficulties with others in the interaction session with the help of EAS system. We might take all the parameters of Engage Brain function under consideration. Intellectual ability needs analyzing ability because one must need to analyze the situation to solve a particular problem. Afterwards, their solving capability shall come in handy. Critical thinking is a must for approaching a problem through many different ways. Adding that, people need their lack of attention to be minimized.

We can consider the equation of Intellectual Ability,

$$I_a = Analizing\ abilty + solving\ capacity + Critical\ Thinking - attention\ distortion \quad (2)$$

Attention distortion is given in a sense of lack of mindfulness. The lesser it hinders the rest of the parameters the more the intellectual ability is. Same concept goes for the equation of creativity.

Creativity, $C_r = thinking\ capability + feeling + mindmap - attention\ distortion \quad (3)$

Motivation is a crucial factor for brain activity. People need freedom and sense of success for the feelings of overcoming the challenge in the near future. Plus another thing is needed very often and that is their willingness for engagement. So, we can construct an equation of motivation in such way that it reflects all the parameters.

Motivation, $M_o = Freedom + Sense\ of\ success + Willingness\ for\ engagement\ to\ acticity \quad (4)$

Additionally, instructor can always seek help from the EAS system where all the knowledge base resides for building more superior qualitative problem with more possible segments.

3.3 Individual Problem Solving Phase

In this phase students tries to solve a particular problem given by the instructor. The problem requires multiple segmented areas and preferably more than one intellectual solution. Additionally, while solving the particular problem students can save their difficulties in the EAS database for future interaction phase by logging in to their terminal.

The total brain activity can be derived as $Total(B_{activity})$ in a group, where, X is an individual student, P_s is an individual problem segment and Y_i is an individual among the rest of the students Y. Therefore, each of the individual X's total solved segments will be added with the rest of the student Y's in order to obtain $Total(B\_activity)_{Group}$. In this case, the overlapping segments are deducted.

$$Total(B\_activity)_{Group} = [X. \rangle P_{s_i} + \rangle Y_i. \rangle P_{s_i}] - |\rangle Y_i. \rangle P_{s_i}| \ |X. \rangle P_{s_i}| \quad (5)$$

Here, we are focusing on one particular students problem namely X and all of his fellow students belongs to group Y. Since the common knowledge must be subtracted according to set union theory, we have taken union and subtracted to equalize the equation. When one student shall sit for problem after signing in his respective terminal he/she will be treated individually since we are taking an individual X and entire problem set P_s into consideration. In every terminal particular student will be treated as X and all the others as Y.

3.4 Solution Phase

Depending on the equation either the instructor or the students shall try to provide an optimal solution to the previously provided problem segments. Solution is needed either way because a particular student *X* needs to fill the knowledge gaps or fragments. A review might be required before providing the optimal solution. Let us consider the Total Brain Activity equation which has been mentioned before. Let us consider the common problem segments as R. Then the equation can be deduced as,

$$Total(B\_activity)_{Group} = [X. \rangle P_{s_i} + \rangle Y_i. \rangle P_{s_i}] - [R] \quad (6)$$

After re-arranging we get,

$$X. \rangle P_{s_i} = Total(B_{activity})_{\_\_\_\_} + [R] - \rangle Y_i. \rangle P_{s_i} \quad (7)$$

In the solution phase, since we are targeting for the individual X's problem P as dependent variable, everything except the X and the X's entire problem solution set we have made as independent variable by rearranging the equation. In the solution phase our system will act for the individual X's problem. We are showing in the equation that group activity is needed for our system since solution of X's individual problem P depends on Total Brain activity in a group. That is how it is related to our system. It signifies that individual's problem depends on Group interaction. If group interaction and knowledge sharing have already been happened there is no necessity of repeating each problem Ps by each of the other individuals Y for a particular person. Otherwise same thing shall be repeated twice. That is why we are removing the overlapping variables.

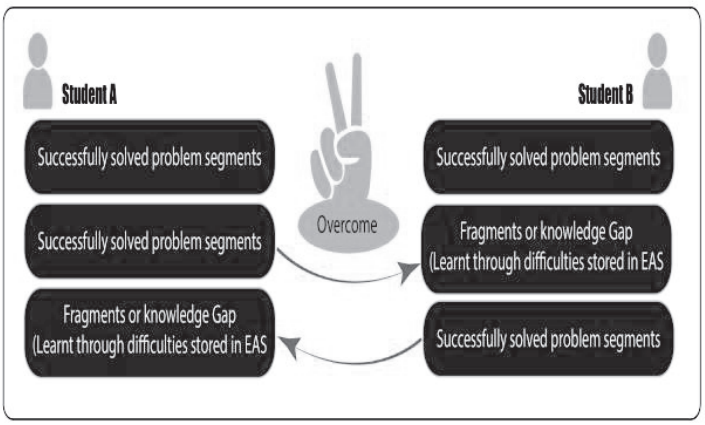

Figure 2: Gaining New Insights

3.5 Interaction Phase

In the interaction phase, students are allowed to perform peer interaction for individual development. Again, stu-dents can take aid from the EAS system to match their difficulties faced in a particular segmented problem with the other students. A review, either by the teacher or the peer groups is required for overcoming the knowledge gap or fragments. Considering previous equation, if we add the other student Y's problem solution for those segments which X could not solve and faced difficulties, we get,

$$X. \rangle P_{s_i} + [\rangle P_{sl} - R] = Total(B_{activity})_{\_\_\_\_} + [R] - \rangle Y_i. \rangle P_{s_i} + \quad |\rangle P_{s_i} - R| \quad (8)$$

This part $\sum_{l=1}^{n} P_{sl} - R$ is called the review section after removing the common segments R of the particular segmented problem.

While students are interacting with their respective peer group, the teacher can view student's difficulties in EAS in order to provide more holistic solution. Additionally, the teacher can view difficulty pattern generated by the EAS system for more deep understanding. Note that we tried to identify each X's individual weakness through their faced difficulty set. The reason is, Gestalt principal of Closure quotes "Object grouped together is seen as a whole". We might compare the problem segment's solution as objects described in the principal. All of these segments of a particular problem can only be solved if each segment's solution is grouped with others. Holistic solution can easily be found if the problems are identified through the difficulties faced by the students and different students with different solutions are grouped together. That is why, the interaction phase is valuable. In our whole model, a review either by peer group or by the teacher is needed the review is indicated by $\sum_{i=1}^{n} P_{si} - R$ the equation in the both sides. By doing this, X's fellow group mates shall be able to revise their particular solved problem P's solution. This equation has been stated to realize the effectiveness of peer interaction, overcome the knowledge gaps and revision for those who have actually solved the problem. That is in our system peer interaction is very much needed to overcome the knowledge gaps.

3.6 Gaining New Insights

After all the phases being completed, a student can gain insight through individual problem solving and group interactions. After gaining new insights student shall log in to their EAS account and store their individual insights under particular problem headers. This insight building capability storage shall help the model to get better at times. Gestalt theory of similarity [8] says about elements possessed of similar properties (e.g., concepts, texture, shapes, color etc) are more likely to group together than the elements distributed with dissimilarities. As a result, while peer discussions students might be able to find their similarities (in this case, the problem segment's solution label). If they can find the similarities, it is possible that they will be able to find that, how their solution and difficulties differ from the members of other peer groups. In order to gain new insights, these activities are very much required.

We can consider gaining new insight as a dependent variable of prior knowledge and solving a particular problem with brain activity.

The new insight can be depicted as *NI*,

Where,

NI is the new insight,

Pr is the prior knowledge,

$$NI := Pr + Solve(Br_{activity}) \tag{9}$$

From Equation (1), if we substitute the values of $Br_{activity}$ to equation (9), we get,

$$NI := Pr + Solve((EngageBrain(I_a, C_r, M_o)_{env} + Feedback)) \tag{10}$$

Here, in our system gaining new insight has been depicted by the solve function and their prior knowledge. After the substitution Feedback has been added by their fellow groupmates to gain new insight.

4 The Schema of EAS

The schema diagram of the EAS might possess following tables and fields according to figure 3. In the schema there are five tables (Difficulties, Problems, Account, Gained insights, Segments) including the primary key and foreign key. Each of the table can resemble a table in a database which can run parallel in accordance with the combination of different front end and back end programs.

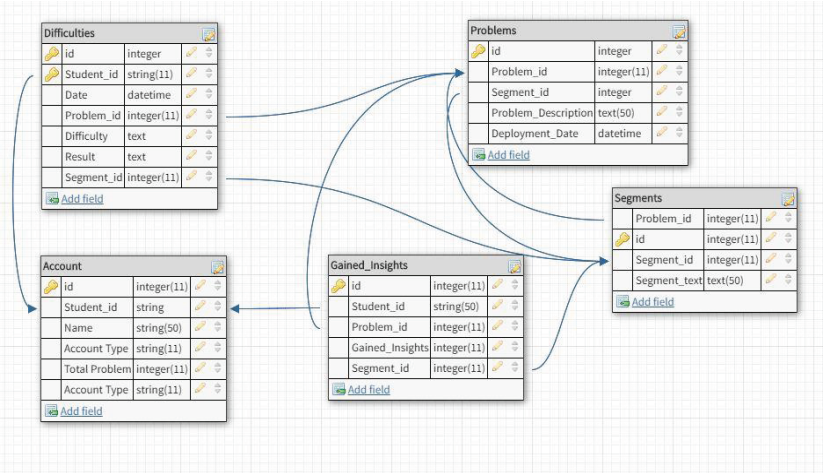

Figure 3: Schema of EAS System

5 SIGNIFICANCE

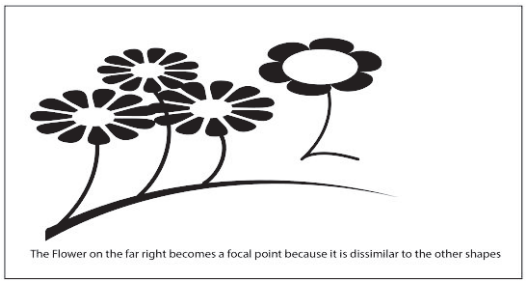

Figure 4: An illustration of the Gestalt theory of similarity

If you are using Word, use either the Microsoft Equation Editor or the MathType add-on (http://www.mathtype.com) for equations in your paper (Insert | Object | Create New | Microsoft Equation or MathType Equation). "Float over text" should not be selected.

Number equations consecutively with equation numbers in parentheses flush with the right margin, as in (1). First, use the equation editor to create the equation. Then, select the "Equation" markup style. Press the tab key and write the equation number in parentheses. To make your equations more compact, you may use the solidus (/), the exp function, or appropriate exponents. Use parentheses to avoid ambiguities in denominators. Punctuate equations when they are part of a sentence, as in

$$\int_0^{r_2} F(r,\varphi)\, dr\, d\varphi = [\sigma r_2 / (2\mu_0)] \cdot \int_0^{\infty} \exp(-\lambda\,|\,z_j - z_i\,|)\,\lambda^{-1}\, J_1(\lambda r_2)\, J_0(\lambda r_i)\, d\lambda\,. \tag{11}$$

Be sure that the symbols in your equation have been defined before the equation appears or immediately following. Italicize symbols (*T* might refer to temperature, but T is the unit tesla). Per IEEE Computer Society, please refer to "(1)," not "Eq. (1)" or "equation (1)," except at the beginning of a sentence: "Equation (1) shows ... ." Also see *The Handbook of Writing for the Mathematical Sciences*, 1993. Published by the Society for Industrial and Applied Mathematics, this handbook provides some helpful information about math typography and other stylistic matters.

Please note that math equations might need to be reformatted from the original submission for page layout reasons. This includes the possibility that some in-line equations will be made display equations to create better flow in a paragraph. If display equations do not fit in the two-column format, they will also be reformatted. Authors are strongly encouraged to ensure that equations fit in the given column width.

6 A PRACTICAL EXAMPLE OF THE SCENARIO

Our model might create significant impact on both student's individual and group wise development. While they are solving prob-

lem segments individually, they shall be able to connect their ideas, creativity and intelligence with their prior knowledge with the present challenge and build new insights. Again, by storing their difficulties regarding the segments while solving a particular problem in EAS, they shall be able to highlight their weakness by themselves. Afterwards, their weakness shall be greatly identified and purified in peer interaction phase. Moreover, students shall be able to gather their ideas as a whole by filling the gaps of their knowledge by peer interaction. Gestalt theory of similarity depicts that people often perceive the similar objects as a group and the group might create a pattern (Figure 4) [8]. On the contrast, an object can be however emphasized based on their dissimilar properties among all those objects which possess similar properties. Those dissimilar objects can become the focal point and easily identified. We call this anomaly [8].

Our model based on the Education Aid System (EAS), intends to emphasize on various difficulties faced by the students while solving the segments of a certain problem given by the instructor. For an example, M number of students within a group faced n numbers of difficulties while solving the problem segments. Among these n numbers of difficulties, supposedly y number of difficulties is similar to each other. Then, there shall be some difficulties $z= (n-y)$, which shall be dissimilar among all. We are assuming that, each and every student shall have at least one z which shall be highlighted easily. New insights can be built and stored inside the EAS for a particular problem set that might prove to be helpful in the future. According to another principle of Gestalt named Figure and Ground principle [8], shape can be naturally absorbed as figure (Object) while the surrounding area works as the ground (background). In total, the object can be emphasized enough to be visualized in the ground very easily by human eye (Figure 5).

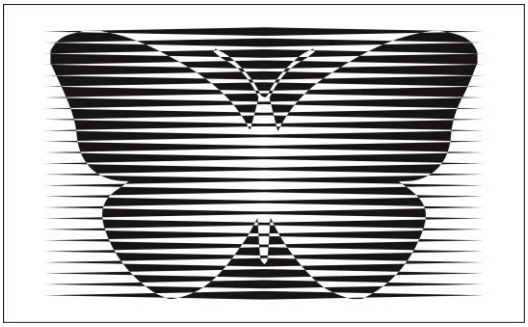

Figure 5: An illustration of Gestalt theory of Figure and Ground

Here in our model, the peers are working as the ground and the individual student as the figure or the object. Additionally, the problems tend to be given by the instructor shall be designed in such a way that holds continuation to the basis of the next problem. As Gestalt theory of continuation says that, our eyes tend to move through the objects which have continuous anchor (Figure 6).

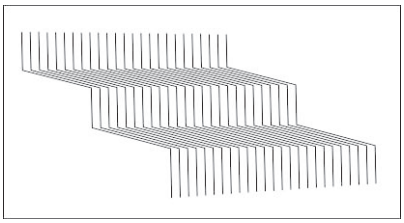

Figure 6: An illustration of Gestalt theory of Continuation

The EAS system of our model shall provide a way to do so. In total, students perceptual and concept development of their individual being has been done through peer interaction which might prove to be helpful for their future employability.

In case of dealing with various problems prevailing in students' future working environment, they might be able to build new insights (based on their present intellectual abilities which they have already developed in the class room) for solving problems in an efficient manner to ensure their better employability remains viable. Involvement of mind, intelligence and creativity aspects of the Gestalt theory gained by the students in their university environment would be pertinent assets for future career and continuous professional development. Therein, theory of proximity and continuity shall enlighten an individual with proper utilization of their mindfulness and create a tolerance of bearing a challenge further. The lessons of the theory of similarity shall create a focal point to highlight aspects of the future challenges towards employability and uphold the dedication level to some extent. Finally, individuals enlighten with the essence of Gestalt theory shall prove valuable in terms of conceptual, technical and creative skill set.

7 Model overview in Practical classroom

To demonstrate the model over a practical class room scenario, let us assume some programming related problems. Suppose teacher gave 10 programming problems under some time constrains. While solving their programming related problems students log in to their EAS account and adds what difficulties they are facing for solving a particular problem. It can be easily illustrated by figure 7.

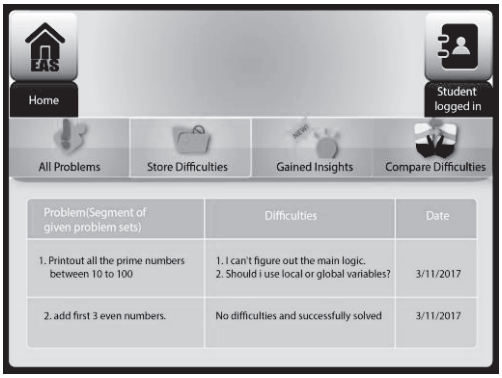

Figure 7: Storing difficulties User Interface

Let us assume, one particular student solved 6 problems and stored the difficulties for the rest of the problems. The rest of the problems can be easily identified and solved by other group mates. In the interaction phase students in a group compares their difficulties with other group mates. We would do this kind of matching by comparing texts under difficulty tab in the back-end system and provide students with a result such that they shall eventually know his difficulty matches with which group mates. They might be able to check both individually with another student and in a total group.

They might be able to compare themselves with the other group mates by inserting their ids. However, teacher would be able to view all the students' difficulties and help each particular group to solve. If a particular problem have not solved by any of the students interacting within a particular group, then the teacher should come forward and try to solve. The comparing difficulties module should look like figure 8's illustration.

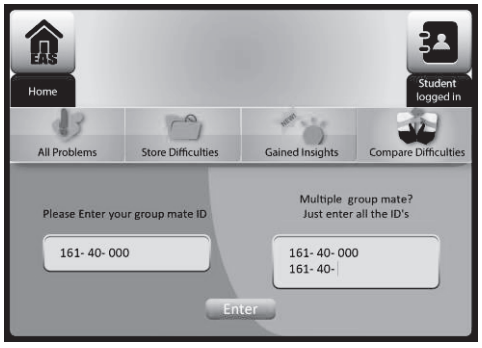

Figure 8: Comparing Difficulties User Interface

They might be able to compare themselves with the other group mates by inserting their ids. However, teacher would be able to view all the students' difficulties and help each particular group to solve. If a particular problem have not solved by any of the students interacting within a particular group, then the teacher should come forward and try to solve. The comparing difficulties module should look like the figure 9.

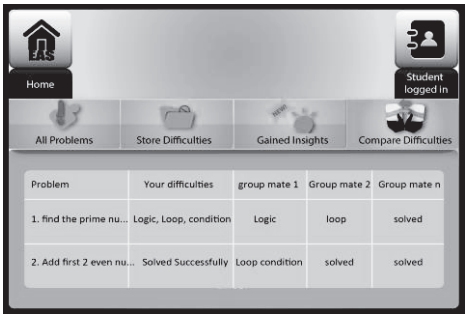

Figure 9: Comparing Difficulties with others User Interface

8 Conclusion

There is no doubt that the Gestalt theory of learning has a lot of practical application in an educational setting regardless of the grade levels. In this paper, students' problem solving abilities and development of insights as per the lessons learned from the theory have been incorporated within a computer supported learning environment called 'Education Aid System (EAS)' which may be regarded as an innovative approach of the Gestalt theory of leaning. This problem solving model defines the role of a class room teacher who introduces and discusses the topic and assigned the task (problem) to the students and the responsibilities of the students for solving the problem in a holistic approach. The EAS provides an opportunity for interaction amongst the participating students for comparing thoughts, critical thinking abilities and development of insights of the group members. So, sharing experience in the form of interaction is another innovation of this model, which we have already shown in figure 1 and figure 2. The complete learning activities of the students in different phases in EAS environment such as, engage brain, intellectual abilities, creativity, motivation, interaction, distortion etc. are shown using mathematical equations. It is claimed here that the intellectual abilities gained by the students from EAP may contribute to deal with different problematic situation during their professional life. A Schema Diagram of the EAS learning environment is also presented for broader understanding and future work. Development of the proposed Education Aid System is left for the future effort. In addition, application of the system in a teaching-learning environment would reflect the worthiness of the model.

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