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Park Malaysia, 57000 Kuala Lumpur (MY).(72) Inventors: **KHALIL, Ben Mohamed**; c/o MIMOS Berhad, Technology Park Malaysia, 57000 Kuala Lumpur (MY). **FAROUQ, H Hamed**; c/o MIMOS Berhad, Technology Park Malaysia, 57000 Kuala Lumpur (MY). **JAS-BEER, Singh Atma Singh**; c/o MIMOS Berhad, Technology Park Malaysia, 57000 Kuala Lumpur (MY). **LIM, Ying Sean**; c/o MIMOS Berhad, Technology Park Malaysia, 57000 Kuala Lumpur (MY). **DICKSON, Lukose**; c/o MIMOS Berhad, Technology Park Malaysia, 57000 Kuala Lumpur (MY).(74) Agent: **YAP, Kah Hong**; Pyprus Sdn Bhd., Suite 8-02, 8th Floor, Plaza First Nationwide 161, Jalan Tun H.S. Lee, 50000 Kuala Lumpur (MY).

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[Continued on next page]

(54) Title: METHOD FOR COLLABORATIVE LEARNING BASED ON DIVIDE-MASTER-LEAD STRATEGY IN AN INTELLIGENT COLLABORATIVE LEARNING SYSTEM

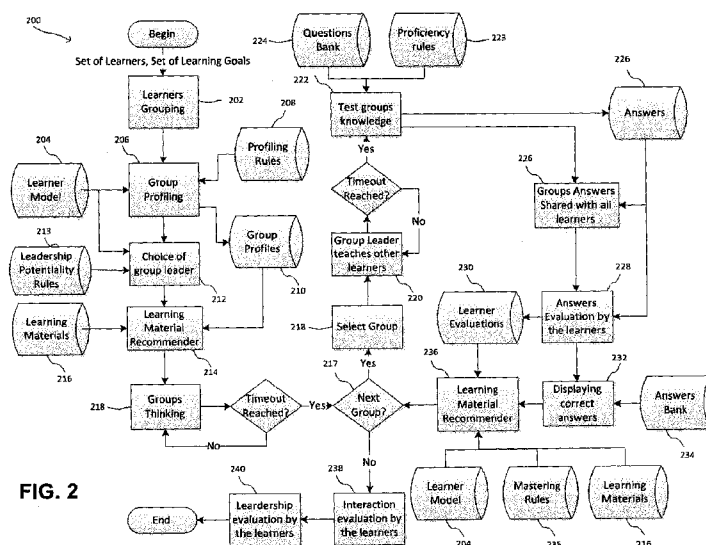


FIG. 2

(57) Abstract: Method for Collaborative Learning Based on Divide-Master-Lead Strategy in an Intelligent Collaborative Learning System The present invention provides a method for providing collaborative learning for learners. The e-learning model provides a "divide-master-teach" strategy where the learners are divided (202) in groups where the learners try to master the learning materials as a group. A group leader is selected (212) for each group, and the group of learners will be tested with a set of questions assigned to them. The learners are to evaluating (230, 238, 240) the answers and the interactions between the learners. The evaluation results are utilized for recommending new reading materials and selecting new leaders for the groups. An e-learning platform is also provided herewith.



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Method for Collaborative Learning Based on Divide-Master-Lead Strategy in an Intelligent Collaborative Learning System

Field of the Invention

[0001] The present invention relates e-learning system. In particular, the
5 present invention relates to a system and method for collaborative learning, which is
carried out without teacher or tutor.

Background

[0002] The existing collaborative learning environments always involve a
teacher or tutor to drive the collaborative learning session. The current research in the
10 collaborative learning community is more focused on how to provide a good
collaborative learning session in terms on of the optimal size of the class, etc. and on
designing efficient collaborative learning strategies to be implemented by a true teacher
or tutor in a classroom or in an online environment.

Summary

15 **[0003]** In accordance with one aspect of the present invention, there is provided
a method for providing collaborative learning for learners. The method comprises
dividing the learners into a plurality of groups based on learning goals; profiling the
groups with profiling rules based on the learners' profiles; selecting a group leader for
each group with leadership potentiality rules; recommending learning materials based
20 on the group profile of the respective group; dedicating a leader of one group to guide
another group based on the recommended learning materials within a prescribed time
period; testing the learners as a group with a set of questions according to the learning

goal and group proficiency rules; evaluating the answers provided by learners in response to the questions; recommending further learning materials to the learners based on the learners' evaluations; and evaluating interactions with other learners and leadership of the group leader.

- 5 **[0004]** In one embodiment, the profiling the groups with profiling rules further includes calculating a group proficiency based on a proficiency of the learners of the group over proficiency rules; calculating a group interaction history based on interaction history of the learner of the group over interaction history rules; and calculating a group cognitive profile based on a cognitive profile the learners for the
- 10 group over cognitive profile rules.

- [0005]** In a further embodiment, the selection of the group leader for each group further includes computing a potentiality for each learner for being the group leader based on a fixed quota, the proficiency of the learner, the previous leadership evaluations of the leader; and selecting the group leader among the learners with a
- 15 highest computed potentiality. It is possible that the selection may further comprise selecting a volunteering learner as the group leader; selecting the volunteering learner with the highest computed potentiality when more than one volunteering learners are available.

- [0006]** In yet a further embodiment, testing the learners as a group may further
- 20 comprise answering the questions by each learner of the group; sharing answers from all the learners; selecting a group answer that is agreeable by the learners.

[0007] Yet, recommendation of the learning materials may be further based on the group cognitive profile, the learners' answers, the learners' evaluations on the answers.

[0008] In another further embodiment, evaluation of the answer provided by the learners may further comprise evaluating each answer contributed by each learner; and
5 stating a confidence degree of their respective evaluation.

[0009] In another aspect of the present invention, there is also provided an e-learning platform for facilitating a collaborative learning over a communication network. The collaborative learning is carrying out according to the aforesaid method.

10 [0010] In one embodiment, the platform comprises a group profiling component for dividing and profiling the learners into groups; a leader selector for selecting the group leader for each group; a learning material recommender for recommending learning materials to the groups; a tester for providing questions and answers to the learners; and an evaluator for receiving evaluations from the learners.

15 [0011] In another embodiment, the platform further comprises a discussion room for learners to discuss among the group to master the learning materials; and a database for storing learners' profiles, processing rules, learning materials, test questions and answers and evaluation results.

Brief Description of the Drawings

20 [0012] Preferred embodiments according to the present invention will now be described with reference to the figures accompanied herein, in which like reference numerals denote like elements;

[0013] FIG. 1 illustrates a flow of an e-learning model in accordance with one embodiment of the present invention;

[0014] FIG. 2 illustrates a block diagram of an overview process of the collaborative learning system based on a Divide-Master-Teach DMT strategy in
5 accordance with one embodiment of the present invention;

[0015] FIG. 3 illustrates a process of group profiling carried out by the group profiling component of FIG. 2 in accordance with one embodiment of the present invention;

[0016] FIG. 4 illustrates a process flow of a group leader selection carried out
10 by the group leader selection component in accordance with one embodiment of the present invention;

[0017] FIG. 5 illustrates a process flow of testing pairs knowledge carried out by the group test knowledge component in accordance with one embodiment of the present invention;

15 [0018] FIG. 6 illustrates a process of evaluating answers through an answer evaluation component in accordance with one embodiment of the present invention; and

[0019] FIG. 7 illustrates a process from of recommending learning materials through the learning material recommender in accordance with one embodiment of the present invention.

Detailed Description

[0020] Embodiments of the present invention shall now be described in detail, with reference to the attached drawings. It is to be understood that no limitation of the scope of the invention is thereby intended, such alterations and further modifications in the illustrated device, and such further applications of the principles of the invention as
5 illustrated therein being contemplated as would normally occur to one skilled in the art to which the invention relates.

[0021] FIG. 1 illustrates a flow of an e-learning model in accordance with one embodiment of the present invention. Briefly, the e-learning model comprises three
10 main processes, namely, divide 110, master 120 and teach 130. For simplicity, the e-learning model is also referred herein as “Divide-Master-Teach” or DMT strategy. The DMT strategy is adapted in a collaborative learning environment. The DMT strategy is a teacher-less learning platform allowing learners to experience e-learning.

[0022] Briefly, the divide 110 step includes grouping learners according to the
15 number of learning goals and profiling (or dividing) the groups accordingly. A group leader is selected for each group based on several properties. Once the learning groups are formed (or divided), the master 120 step recommending learning materials to each group. During the master 120 step, the learning materials are personalized to each group based on their respective cognitive profile. With the learning materials, the
20 learners are giving a period of time to master the recommended learning materials. The learners of the respective learning groups are required to learn think and share as a group.

[0023] After the master stage, the leader is expected to lead and teach all the group learners in the teach 130 step. This teaching step is also conducted in a reasonable about of time period. Each group is being tested thereafter. The test is also conducted as a group test where the learners are allowed to discuss and answer the test

5 accordingly within a given time period. Subsequently, the answers from the different groups will be shared, and the learners shall evaluate the answers from the other groups. Once the evaluation period is over, the correct or recommended answers will be given to all the learners as reference. Further learning materials will also be recommended, when necessary. The teaching and testing stage will be repeated until the groups

10 leaders have taught the other learners. In one illustrative example, given that there are 3 groups of learners, Group A, Group B and Group C, and learner X, learner Y and learner Z are the leader of groups respectively, learner X will teach the learners from his Group A and also the learners from Group B and Group C. Learners from Group A may also assist their leader. Learner A to teach the other learners from other groups

15 Group B and Group C. After the teaching session from Group A, the test, evaluation and potentially learning material recommendation will be carried out subsequently. Once the teaching session by Group A is completed, the Learner Y (with/without the other learners from Group B) will teach the learners of Group B and then learners from Group A and Group C, and the test and evaluation and potentially learning material

20 recommendation will be carried out subsequently. After that, similarly, the Learner Z (with/without the other learners from Group C) will teach the learners of Group C and then learners from Group A and Group B, and the test and evaluation and potentially learning material recommendation will be carried out subsequently.

[0024] Learners will then further evaluate the interactions with other members of their own group as well as the leadership of their group leader. New leader may be selected for the next learning curve.

[0025] For simplicity, the time period given for mastering the materials will be referred as "learning period", the time period given for teaching will be referred as "teaching period" and the time period given for the test will be referred as "testing period".

[0026] FIG. 2 illustrates a block diagram of an overview process 200 of the collaborative learning system based on a Divide-Master-Teach DMT strategy in accordance with one embodiment of the present invention. The DMT strategy is adapted to carry out an e-learning without a teacher or tutor as such, i.e. learners learn from each others through the DMT strategy. Initially, the learners' profiles and a set of learning goals will be fed into the system. A learners grouping component 202 forms n number of groups based on n number of learning goals. The groups are then being profiled at the group-profiling component 206. The group-profiling component 206 further receives input from the learner model database 204 and a profiling rules database 208. A cognitive profile and a proficiency level are tag to each group based on their attributes of the group members. The group profiles are then stored on the group profiles database 210.

[0027] Subsequently, a leader selector 212 will select a leader for each group based on a leadership potentiality rules stored on a leadership potentiality rules database 213. Once the group leaders are selected, a learning material recommender 214 recommends suitable learning material based on the group profiles from the group

profiles database **210**. The learning materials are stored on a learning materials database **216**. In one illustrative example, {learning goal = understanding addition}, {cognitive profile = visual group}, then a videos learning materials explaining the addition will be recommended.

5 **[0028]** A group-thinking component **218** will assign a learning period for the learners. Within the learning period, the learners may do their own research, discuss among the group learners to understand the learning materials and to master the same to achieve the learning goal as a group. The system may facilitate virtual discussion/chat/conference rooms, forums, etc. for group discussions, which can be led
10 by the leader of each group. During the learning period, the groups are not allowed to correspond with another. Once the learning period expires, i.e. timeout, it is determined if all the groups already taught the other groups at step **217**. If no other group is to be taught, the learners may individually rate their interaction with the group members at step **238** as well as to rate the leadership of the currently appointed leader at step **240**.
15 For example, John, Jack and Mary were in the same group with Mary as the group leader, John can rate his interaction with Jack and Mary by giving a score from 0-10 and rate the leadership of Mary with a score between 0-10, say 7.

[0029] When there are more groups to teach others, then the system selects the next group automatically at step **218**. . The selection is done based, for example, on the
20 easiest learning goal attached to the group, i.e. the learning goal that has no pre-requisite among the set of learning goals. In one illustrative example, the groups A and B are respectively working on the learning goals “additional” and “multiplication”, and assuming that “addition” is a pre-requisite for “multiplication”, one way would be to start with the group that is working on “addition”.

[0030] Once the selection is done, the group leader of the selected group teaches all the other learners from all groups within the teaching period at step **220**.

[0031] Once the teaching period expires, i.e. timeout, a Test Groups Knowledge component **222** creates a test for each group based on the learning goal, and the group proficiency rules **223** to assess the learners' knowledge. The test includes questions from a question bank **224**. The learners of a group answer as a group, if the learners may come to a common agreement on one answer, or as individual learner if no agreement can be reached among the learners of the group. After all the groups answered the test, the questions and the respective answers from all the groups (or individuals) are displayed to all the learners at step **226**. All the answers, whether or not they are correct, are stored on an answer database **226**.

[0032] Each learner can evaluate the answers of his/her peers as well as his/her own answer at step **228**. The learners' evaluations are also recorded on a learner evaluation database **230**. The correct answer taken from the answer bank **234** is then presented to the learners at step **232**. Following that, a learning material recommender **236** receives learners' profiles from the learners' model **204**, the answers from each learners, the learners' evaluations of the answers and the correct answer to determine its recommendation for the subsequent learning materials. The learning material recommender **236** also considers the mastering rules from a mastering rules database **235** for coming out with its recommendations. The entire learning process is looped back to the step **217**.

[0033] **FIG. 3** illustrates a process of group profiling carried out by the group profiling component **206** of **FIG. 2** in accordance with one embodiment of the present

invention. The process starts with setting proficiency of the group at step **302**. The group proficiency is computed based on the learners' proficiency stored on the learner model **204** and a series of predefined Profiling Proficiency Rules **208a**. Examples of the learners' proficiency and profiling proficiency rules **208a** may includes: {learner1's proficiency = 1 (Beginner)}, {learner2's proficiency = 4 (Expert)}, {learner3's proficiency = 3 (Proficient)}, {rule = average of proficiencies}, and the resulting group proficiency will be 2.66 that can be round up to 3 as the group proficiency. Next, the system sets the interaction history of the group at the step **304**. The interaction history of the group is computed, similarly, based on the interaction history of the learners obtained from the learner model **204** and a series of predefined profiling interaction history rules **208b**. For example, learner1 and learner2 are in the same group and learner3 is in another group {learner1's interaction history = (learner3, 5)}, {learner2's interaction history = (learner3, 3)}, {rule = average of interaction values} then the output will be (learner3, 4)} 3. Further, the system sets the cognitive profile of the group at step 306. The cognitive profile is computed based on the learners' cognitive profile obtained from the learner model cognitive profiling rules **208c**. For example, {learner1's cognitive profile=(80, 30, 40)}, {learner2's cognitive profile=(40, 20, 10)} {learner3's cognitive profile=(60, 10, 40)}, {rule=average of cognitive profile values} then the output will be (60, 20, 30).

[0034] FIG. 4 illustrates a process flow of a group leader selection carries out by the group leader selection component **212** in accordance with one embodiment of the present invention. The input is a group of learners, and the system starts by computing the leadership potentiality for each learner **402** based on several properties, such as proficiency, previous leadership evaluations, and on a series of leadership potentiality

rules **213**. For example, {learner1's proficiency = 1 (Beginner)}, {learner2's proficiency = 5 (Expert)}, {learner2's evaluation = 2}, {rule = sum proficiency and evaluations} then the computed leadership potentiality will be (learner1, 3) and (learner2, 7). Let a leadership potentiality rule be {rule1: IF learner was leader n times and n > predefined quota THEN Subtract 10 to his/her leadership potentiality} and assuming that learner2 was group leader 5 times whereas the quota is 3, then the output would be (learner1, 3) and (learner2, -3).

[0035] If there is no potential leader (i.e. with a positive leadership potentiality value), then choose the learner with the highest leadership potentiality value **406**.
 10 Otherwise, ask for volunteering among the potential leaders **404**.

[0036] If there is no volunteering then choose the learner with the highest leadership potentiality value among the potential leaders **410**. Otherwise, choose the learner with the highest leadership potentiality value among the volunteers **408**.

[0037] **FIG. 5** illustrates a process flow of testing pairs knowledge carries out by the group test knowledge component **222** in accordance with one embodiment of the present invention. The compute group proficiency component **502** receives a group of learners and a learning goal as input and compute the proficiency of the group based on each learner proficiency on the learning goal (from learner model **204**) and a series of predefined proficiency rules **223**. For example, {learning goal = understanding addition}, {learner1's proficiency = Beginner}, {learner2's proficiency = Expert}, {rule = if Expert + Beginner then Proficient} then the output will be Proficient.

[0038] Then select set of multiple choice questions **504** from a predefined Question Bank **224**, based on the learning goal and the computed proficiency. For

example, {learning goal = understanding addition}, {computed proficiency = proficient}, {questions bank = {understanding addition: {beginner: Q1, ... Qn}}, {proficient: Qn+1, ... Qm} ...} then choose for example k, (predefined number) questions from Qn+1, ..., Qm}

5 **[0039]** If all questions have been answered, then the process finishes, otherwise the system selects the next question **506**, randomly or based on questions ranking.

[0040] The learners of the group answer individually (they cannot talk to each other) at step **508**. The answers are stored in an answer repository **226**. When a timeout is reached, the system checks if the learners share the same answer at step **510**.

10 **[0041]** If they share the same answer, then repeat step 3, otherwise, the system displays the answers to the two learners who then can compare and discuss **512**.

[0042] Then after discussion and comparison the learners answer again individually **514** and the new answers are stored in an answers repository **226**. Then repeat step 3.

15 **[0043]** **FIG. 6** illustrates a process of evaluating answers through an answer evaluation component **228** in accordance with one embodiment of the present invention. The answer evaluation component **228** receives the learner's information and a set of question-answer pair. The question-answer pair comprises his/her answers to the questions assigned, and the question-answer pairs from the other learners. Once the
20 input is received, the answer evaluation component **228** displays all the question-answer pair to the learners at step **602** for evaluation. The evaluation is done question by question after all answers are being evaluated. So, if all answers have been evaluated,

then the process finishes, otherwise, the answer evaluation component **228** selects the next question-answers at step **604** for evaluation. The selection can be done in a randomly order or based on a predefined order. For example, the order may be started with the questions-answers of other learners and then with the learner questions-
5 answers.

[0044] At step **606**, the learners evaluate or rate the answers presented to them, and the ratings are stored on a learner evaluation repository **230**. For example, a question that states “ $2+3 =$ ” and the answer given by a learner is “4”, the other learner’s rating could be “correct” or “incorrect” or “neutral-do not know”.

10 **[0045]** The learners may then give a confidence score on his rating at step **608**. The confidence score will also be stored correspondingly on the learner evaluations repository **230**. For example, the confidence score may be of any numbers between 0 to 10, where 10 is the most confident level, and anything below 5 will indicate that he is not sure. Once the evaluation is done on one question-answer pair, the component **228**
15 selects another question-answer pair.

[0046] **FIG. 7** illustrates a process from of recommending learning materials through the learning material recommender **236** in accordance with one embodiment of the present invention. The evaluation is done based on the given answer as well as the evaluations on them from the other learners. The learning materials recommender **236**
20 receives input that includes the learner profiles, his/her answer, a correct answer from the answer bank and learning goal. At step **702**, the recommender **236** computes the learning goal mastering progress. The learning goal mastering progress is determined based on the learner’s answer, the correct answer, the learner’s evaluations **230** and

mastering rules **235**. For example, the mastering rule may be “rule1:IF learner answer $\neq$ correct answer THEN 0”, “rule2: IF learner answer = correct answer AND $50\% <$ correct learner’s evaluations $< 70\%$ THEN 5”.

[0047] Then the recommender **236** will choose learning goals tailored to the
5 learner in terms of learning goal, the learner’s cognitive profile taken from the learner model **204** and the learner’s learning goal mastering at step **704**. For example, a learning material with a tag: {LearningMaterial1, understanding addition, visual, 1-3} which means that the learning material “LearningMaterial1” is for the learning goal “Understanding Addition”, for a learner who has a “Visual” cognitive profile and a
10 learning goal mastering between 1 and 3, it will be recommended if the learning falls into the defined category, and the relevant learning will be recommended.

[0048] It is an aim of the present invention to provide a system and method based on the collaborative learning strategy “Divide-Master-Teach” wherein the (learning) session involves only learners, i.e. teacher-less. The embodiments of the
15 present invention provide an automated system for personalizing the session through group profiling, automatic group leader selection, learning material recommendation on knowledge testing and evaluation. It defines sets of learners’ profiles and learning goals. The learners are being grouped and profiled with cognitive profile and proficiency level, and etc. The system recommends the learning materials to the
20 learners so that they could self-learn through these materials. The learners are given time for learning together as a group and a leader is selected among each group to teach the learners. Through the evaluations on interaction and leadership, the learners are recommended with the suitable learning materials. Through the system, learners are able to learn effectively without any teacher or tutor as such.

[0049] While specific embodiments have been described and illustrated, it is understood that many changes, modifications, variations, and combinations thereof could be made to the present invention without departing from the scope of the invention.

Claims

1. A method for providing collaborative learning for learners through an e-learning platform, the method comprising:

dividing (202) the learners into a plurality of groups based on learning goals set on the e-learning platform;

profiling (206) the groups with profiling rules based on the profiles of the learners within the each group;

selecting (212) a group leader for each group with leadership potentiality rules;

recommending (214) learning materials based on the group profile of the respective group;

dedicating a leader of one group to guide another group based on the recommended learning materials within a prescribed time period;

selecting a set of questions stored on the e-learning platform for testing (222) the learners as a group according to the learning goal and group proficiency rules;

receiving input of evaluation (230) of the answers provided by learners in response to the questions;

recommending (236) further learning materials to the learners based on the learners' evaluations; and

evaluating (238, 240) interactions with other learners and leadership of the group leader for selecting a new group leader.

2. The method according to claim 1, wherein profiling (206) the groups with profiling rules further comprising:

calculating (302) a group proficiency based on a proficiency of the learners of the group over proficiency rules (208a);

calculating (304) a group interaction history based on interaction history of the learner of the group over interaction history rules (208b); and

calculating (306) a group cognitive profile based on a cognitive profile the learners for the group over cognitive profile rules (208c).

3. The method according to claim 1, wherein selecting (212) the group leader for each group further comprising:

computing (402) a potentiality for each learner for being the group leader based on a fixed quota, the proficiency of the learner, the previous leadership evaluations of the leader; and

5 selecting (408) the group leader among the learners with a highest computed potentiality.

4. The method according to claim 3, further comprising:

 selecting (404) a volunteering learner as the group leader;

 selecting (410) the volunteering learner with the highest computed potentiality
10 when more than one volunteering learners are available.

5. The method according to claim 1, wherein testing (222) the learners as a group comprising:

 answering (508) the questions by each learner of the group;

15 sharing (510) answers from all the learners;

 selecting (512) a group answer that is agreeable by the learners.

6. The method according to claim 1, wherein recommending (214) the learning materials is further based on the group cognitive profile, the learners' answers, the
20 learners' evaluations on the answers.

7. The method according to claim 1, wherein evaluating (230) the answer provided by the learners further comprising:

 evaluating (606) each answer contributed by each learner; and

25 stating (608) a confidence degree of their respective evaluation.

8. An e-learning platform for facilitating a collaborative learning over a communication network, wherein the collaborative learning is carrying out according to the method of claim 1.

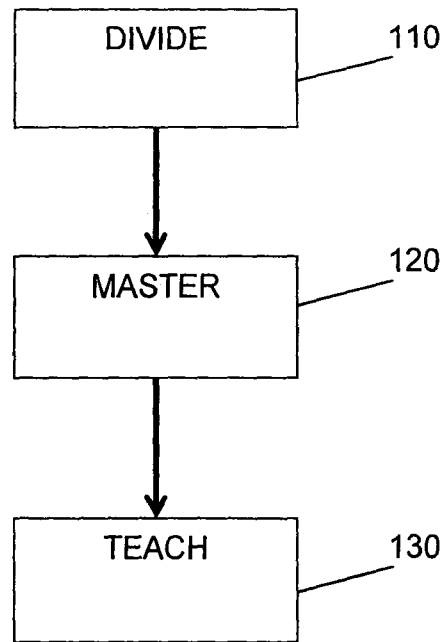
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9. The e-learning platform according to claim 8, comprising:

 a group profiling component (206) for dividing and profiling the learners into groups;

a leader selector (212) for selecting the group leader for each group;
a learning material recommender (214) for recommending learning materials
(216) to the groups;
a tester (222) for providing questions and answers to the learners; and
5 an evaluator (230) for receiving evaluations from the learners.

10. The e-learning platform according to claim 9, further comprising:
a discussion room for learners to discuss among the group to master the learning
materials; and
10 a database for storing learners' profiles, processing rules, learning materials, test
questions and answers and evaluation results.

**FIG. 1**

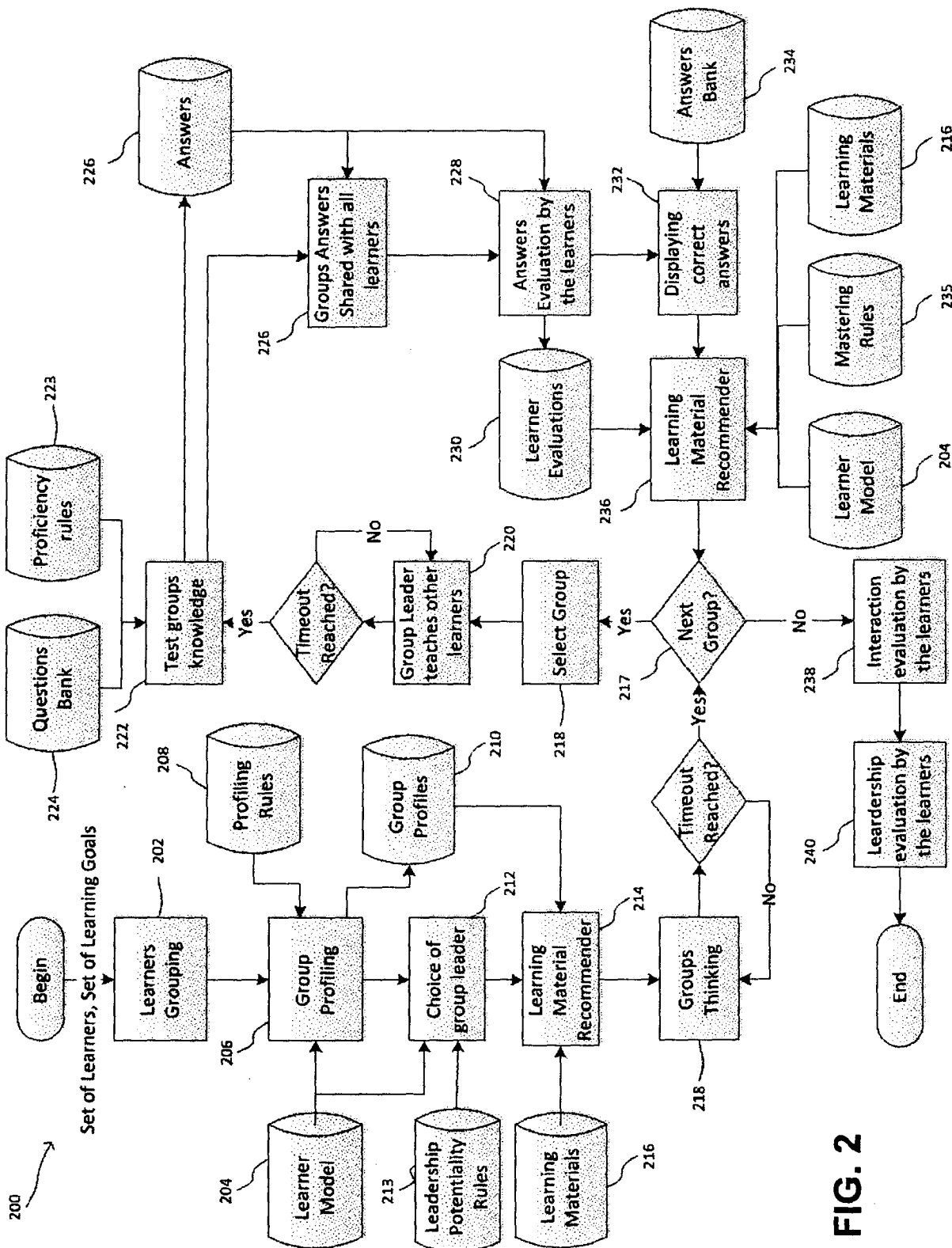
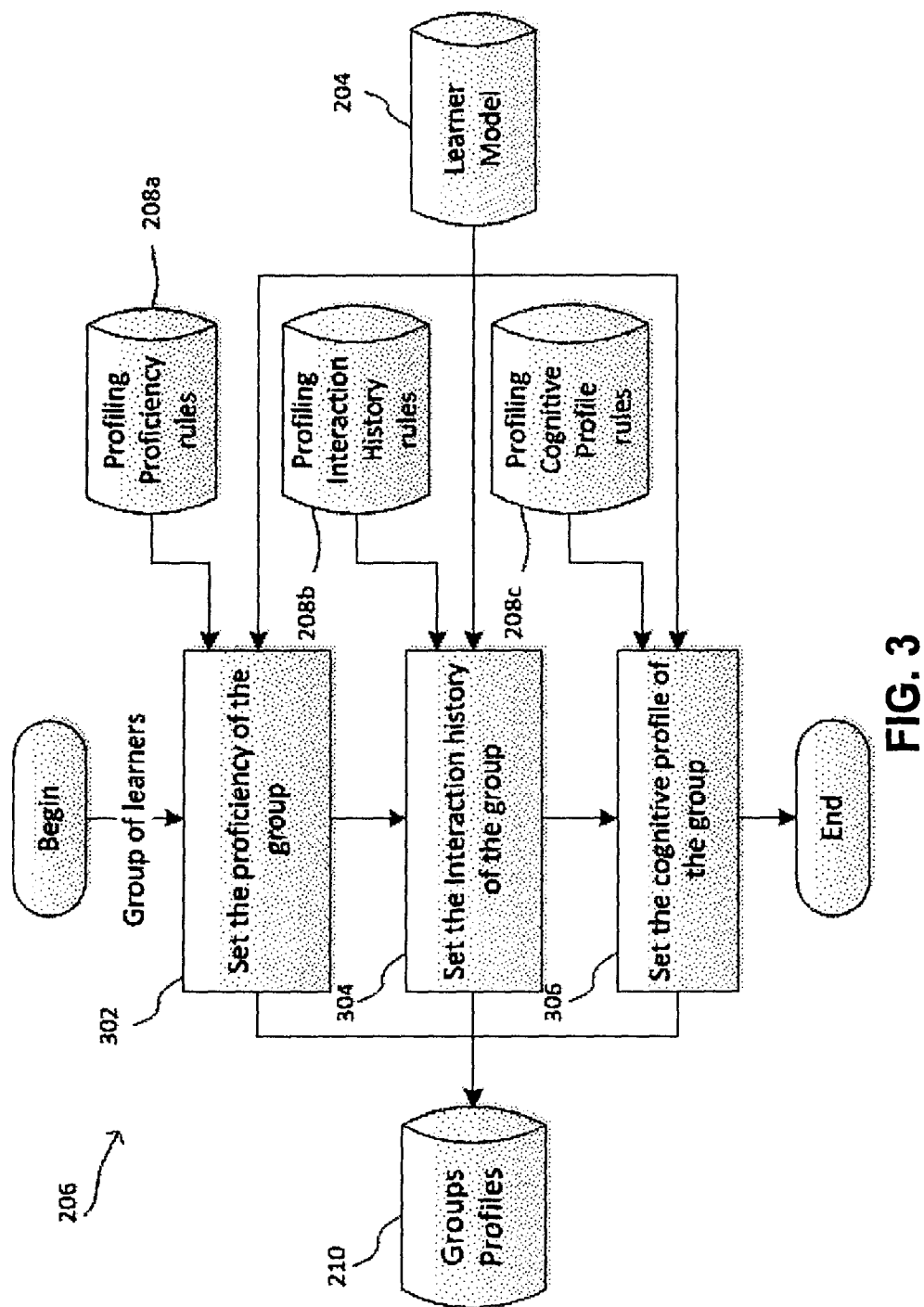


FIG. 2



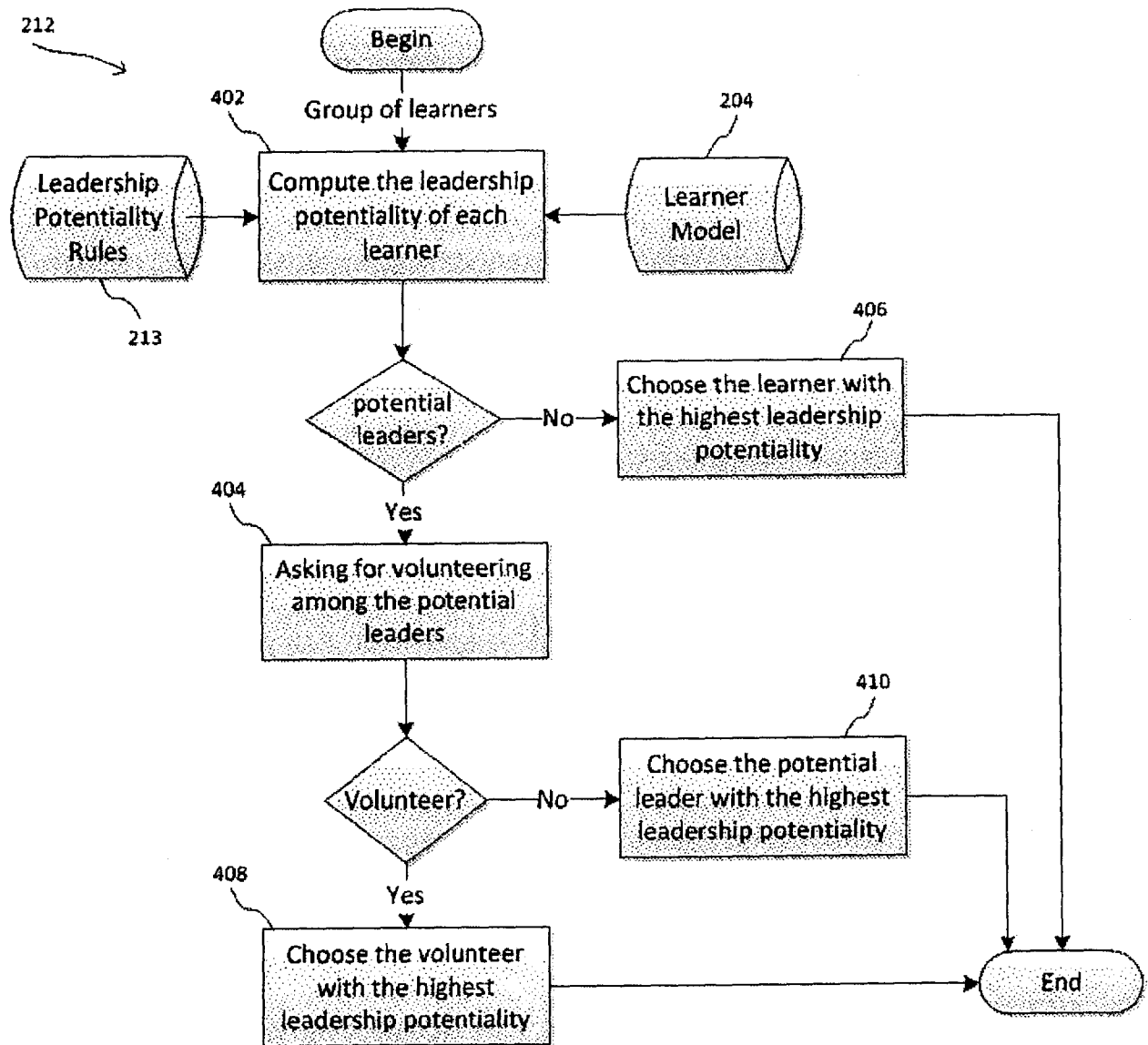


FIG. 4

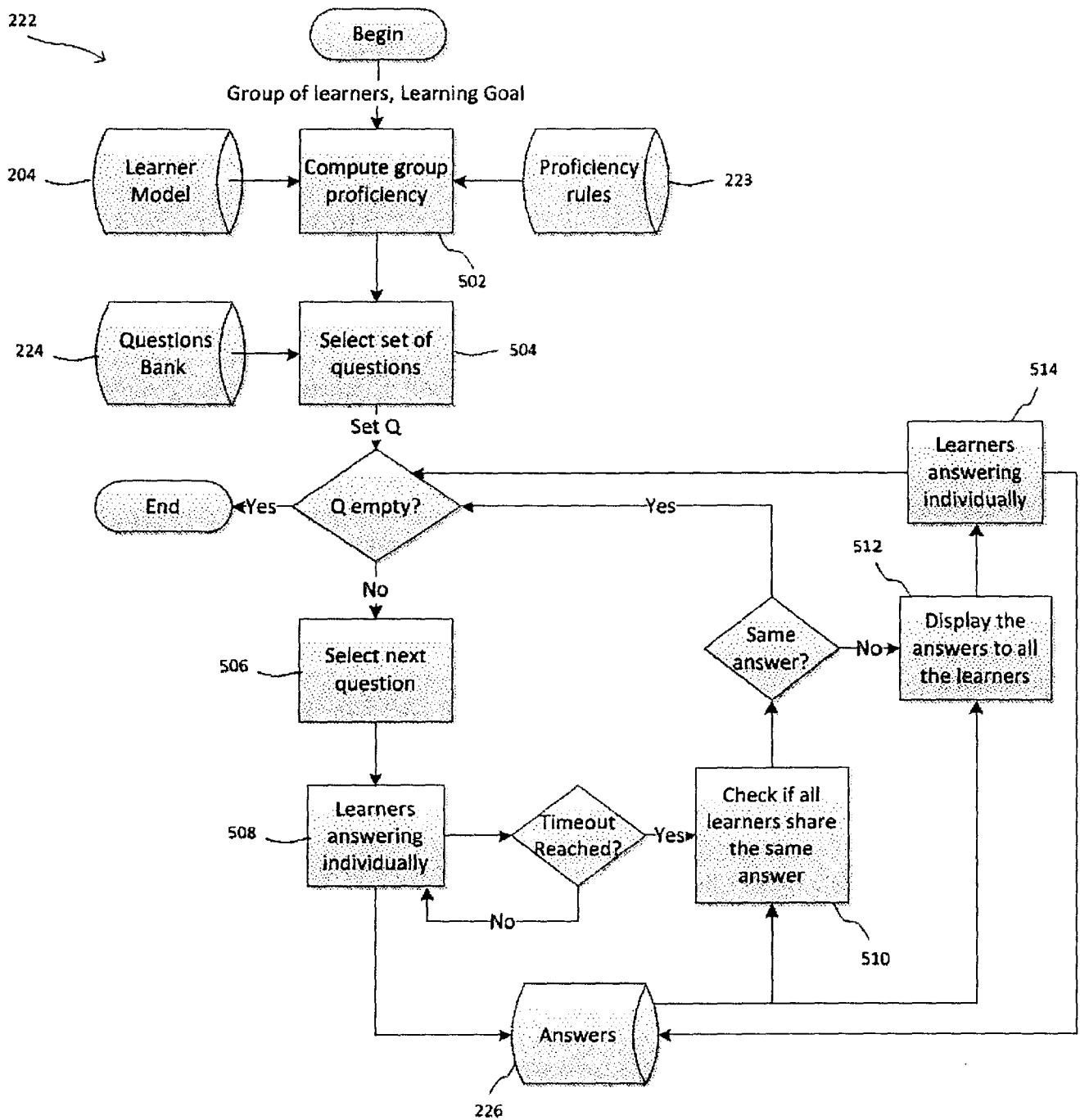
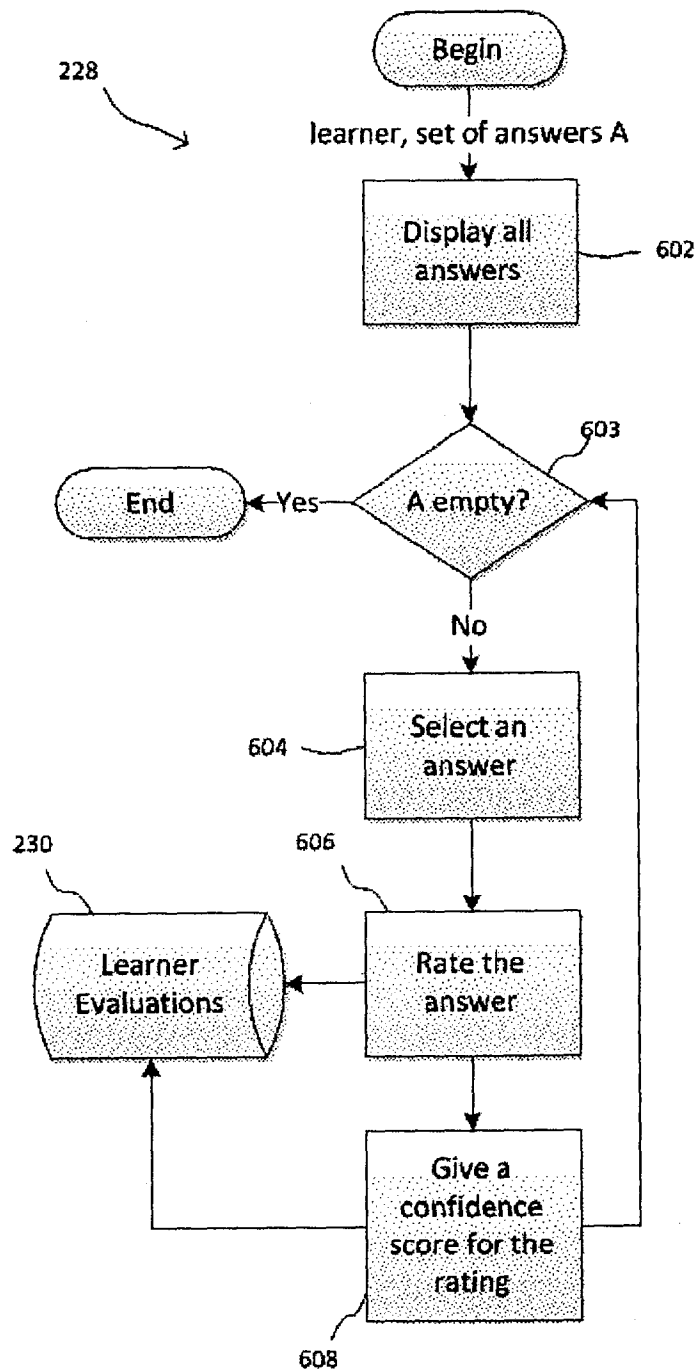


FIG. 5



608
FIG. 6

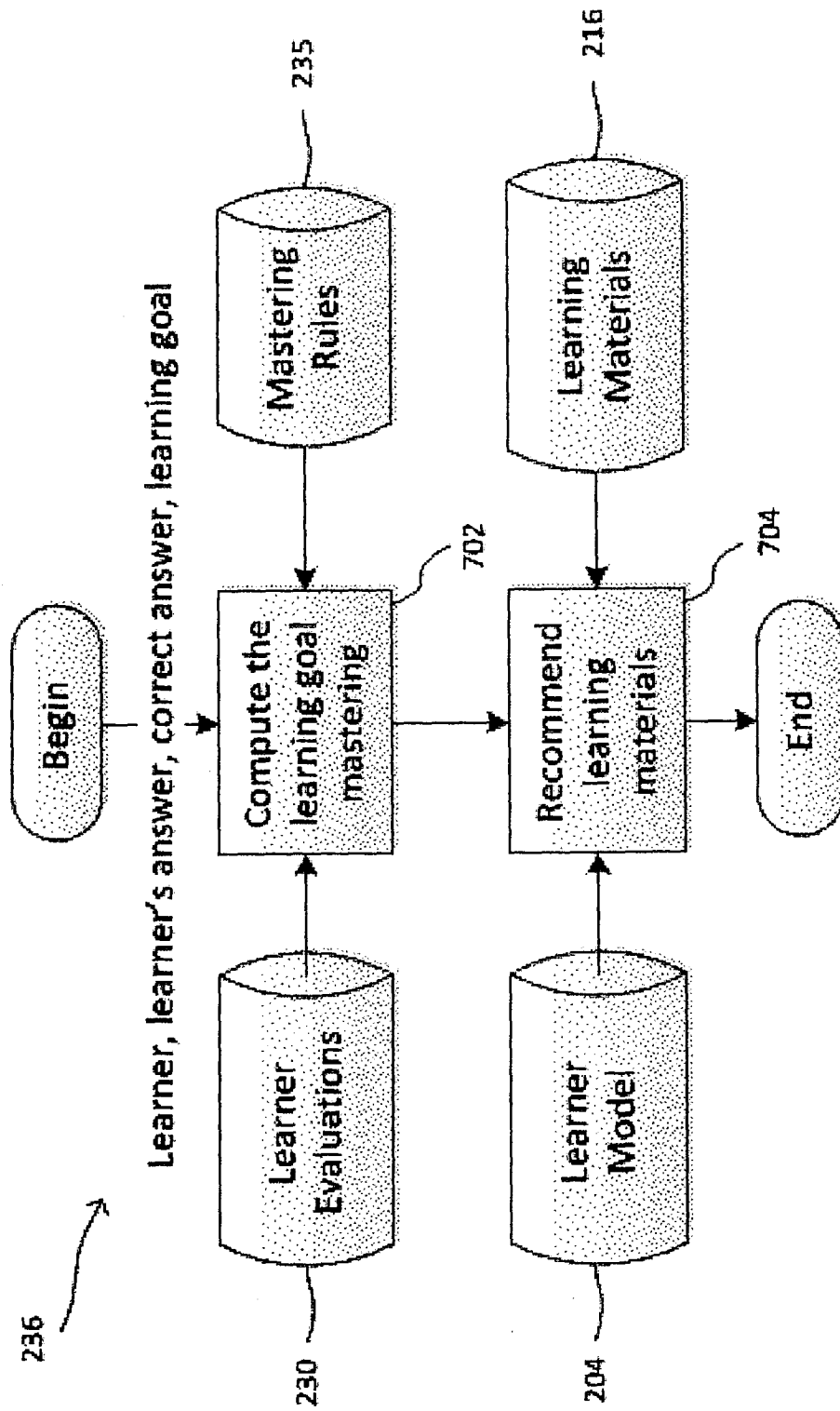


FIG. 7

INTERNATIONAL SEARCH REPORT

International application No
PCT/MY2014/000124

A. CLASSIFICATION OF SUBJECT MATTER
INV. G09B7/08
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
G09B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2013/049907 A1 (CLEVRU CORP [CA]; FOX DANA [CA]; MURDOCH DAVID [CA]; WATERS BILL [CA];) 11 April 2013 (2013-04-11) pages 1-4; claim 1; figures 1-4 pages 6,9,17	1-10
X	US 2005/164154 A1 (SOLOMON NEAL [US]) 28 July 2005 (2005-07-28) paragraphs [0055] - [0056] paragraphs [0079] - [0094] ----- -/--	1-10



Further documents are listed in the continuation of Box C.



See patent family annex.

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Date of the actual completion of the international search

30 October 2014

Date of mailing of the international search report

07/11/2014

Name and mailing address of the ISA/

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040,
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Giemsa, Falk

INTERNATIONAL SEARCH REPORT

International application No

PCT/MY2014/000124

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	"Mi-iLMS: Interactive Learning and Management", 22 July 2011 (2011-07-22), XP054975580, Retrieved from the Internet: URL: http://www.youtube.com/watch?v=l0UKZsgFvIg [retrieved on 2014-10-29] The full video disclosure -----	1-10

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/MY2014/000124

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2013049907	A1	11-04-2013	CA 2813817 A1 11-04-2013
			CN 103503048 A 08-01-2014
			WO 2013049907 A1 11-04-2013

US 2005164154	A1	28-07-2005	NONE
