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'DEVELOPMENTS ON THE DELIVERY OF NON-TECHNICAL MODULES TO ENGINEERING MATERIALS & BIO-ENGINEERING STUDENTS'

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ABSTRACT

Like everything else in life, in business we have to deal with people. A successful manager will have to 'Plan, Organize, Lead and Control'. Each of these four aspects of management requests dealing with people. In the practice of management it will always be 'You' and 'Them'.

To be a successful entrepreneur one requires a number of skills but success will not be forthcoming without 'networking'. Successful networking needs communication skills.

Teaching management to engineering students requires the development of their 'soft' skills. They need to be made aware of not only who they are as persons, what makes them tick and what their moral stand point is but also how to interact and communicate with others.

This paper will give you a flavour of a module created to impart these kinds of skills to students of Engineering Materials and Bio-Engineers.

INTRODUCTION

Recently, Neil Glover, Project Manager University Research RR plc was asked 'What do engineering employers want from our graduates? His answer is summarized in bullet form below:

- Evidence in real interest in solving practical engineering problems
- People who can think around an issue and apply their knowledge to unfamiliar circumstances
- Evidence of applying learning through project work and planning to hit deadlines
- Bright and enthusiastic people who will fit into the team.
- Less concerned with the extent of the candidate's taught knowledge

Clearly today's engineering employers request that our graduates should be able to hit the ground running, possess complex creative problem solving, team working and communication skills, together with adequate knowledge and understanding of business/management issues.

The challenging task for us is to seek the right balance in addressing the demands of modern industry whilst retaining our focus on the student's intellectual developmental needs.

At the Department of Engineering Materials of the University of Sheffield we have developed two modules, soon to be merged into one, that espouse exactly this challenge; MAT388 'Creativity, Innovation, Enterprise, and Ethics', developed by the author and MAT381 'Management for Bio-Engineers' developed by Prof. R. Short and currently also taught by the author.

This paper will provide a short description of how these modules operate, what they hope to achieve and how the students are assessed.

The modules - γνωθι σαυτον - know thyself

"If you are not a viable unit in the ordinary world, you will not become one elsewhere. If you have poor capacity for making human contacts, we cannot offer you the substitute of a community where 'we understand one another'. That belongs to play-life, what some, of course, generally call real life."

From: *Learning how to learn*, Idries Shah.

The starting point for both modules is providing the students with the opportunity of exploring their personal learning and thinking styles [2, 3]. As individuals we are all different and we tend to have different abilities, strengths and ways of solving complex problems. The idea is to get the students to appreciate the differences that exist between themselves as well as help them identify and strengthen their weaknesses in their learning. Work done back in the 1960's at Harvard has demonstrated that two students with nearly identical intellectual capacities can have markedly different abilities in problem solving or intellectual discourse [4].

The graphs shown at the end of this paper provide you with a flavour of the data collected. It can be seen that in general engineering students appear to be well rounded students. Of course the point of the exercise is not only to achieve personal recognition of strengths and weaknesses in our learning in order to be able to work towards future improvement more effectively but to realize that we are different and these differences can be something quite positive in team work as we all contribute different strengths to the group process.

Other researchers [5] have shown that student developmental growth relies on experiential learning opportunities coupled with reflective observation and judgment. During this part of the process the students are introduced to

Kolb's experiential learning cycle [1] and are asked to reflect and discuss their findings as part of a personal portfolio that they will compile over the course of the module. At the tail end of this work an introduction is given as to what do engineers do.

Once this introspective part of the process has been achieved, the students are introduced to the concepts of creativity, innovation and entrepreneurship. The approach is interdisciplinary, thematic and holistic. There is a 'vision' set out for the complete module instead of the traditional specific disciplines. Individual concepts are explored through the use of lectures, group activities, case studies and presentations by practitioners such as economists, industrialists, entrepreneurs, venture capitalists and bank managers. The structure of the module is based on interconnected themes that allow flexibility in the programme without loss of cohesion. Throughout the module the students are provided with background factual information on the financial, accounting, project management, product quality, human resources and managerial aspects of running a business in a holistic manner having spent time on introducing systems and systems thinking. The modules are rounded off by discussing ethics and ethical dilemmas through the use of case studies.

"You can learn more in half an hour's direct contact with a source of knowledge (no matter the apparent reason for the contact or the subject of the transaction) than you can in years of formal effort"

From: *Learning how to learn*, Idries Shah.

The assessment

As already alluded to earlier each student works on a personal portfolio throughout the course of the module. That forms 60% of their assessment. In order to further develop their communication and team work skills, the students are split into groups of four, maximum five and are asked to develop a business plan for a new product or company. The groups are asked to keep minutes of all their meetings as they progress through their group projects and develop a group portfolio. In order to avoid positive or negative discrimination within the groups, members are asked to assess each other's performance and provide explanations and reasons for their assessment. At the end of the module each group makes a presentation of their project to a panel of experts who act as potential venture capitalists who might want to invest in the group's unique ideas.

Team work and the introduction of an element of competition between the groups seem to work very well as motivators. However, we intend to introduce some extra incentives next time round by having actual prizes for best presentation, second and third place via sponsors who are either individual entrepreneurs or industrial organizations.

The result

Feedback obtained by the various cohorts taking these modules has been in general quite positive and the modules have been continuously evolving over the years. We believe that: learning is enhanced when learners are personally engaged in the learning process and they can see the relevance of the subject to themselves and their careers; all learners are different; creative and critical thinking skills are essential for today's global market; learning is a life long process; the need to develop their ability to transfer and apply learning to multiple situations; reflection is very important for assimilation and that the use of technology can enhance the learning process.

We are confident that the modules incorporate the complete experiential learning model proposed by Kolb and that the students are able to hone their communication skills and work cooperatively within their groupings realizing the value of team work in visualizing and implementing solutions to complex problems; the modules provide relevant, interesting and challenging learning experiences giving the students ample opportunities suitable to their particular style of learning; different aspects of learning are synthesised across multiple contexts providing the students with the opportunity to synthesise and the provision of a variety of assessing techniques allows them to take some ownership of the process.

Although students are encouraged to recognise their own learning styles and preferences but these preferences are not used to pigeonhole them in these styles but rather to reinforce the individuality of particular modes of learning and thinking. The value we see from such exercises is that the students reflect on how they learn and they use these findings as a springboard to improve on learning styles that are less comfortable with. Experimenting outside their comfort zones increases their learning experience and helps them become more rounded learners. Analyses of the 'kite' learning profiles of the students can act as a starting point for the lecturers by providing insights as how to best interact with their students. This is useful information for adopting teaching approaches that are suitable for the maximum number of students and also the basis for planning learning opportunities that would cater for those in the minority, e.g. small-group brainstorming activities are extremely effective for experimenter (active) learners, or brief intervals in teaching to allow the students to think through what they have been told allows the reflective thinkers to gain the benefits. Of course this work has a positive effect on staff by making their experiences more rewarding, interesting, fulfilling and valuable. Education is both an art and a science and we believe that engaging in educational research as part and parcel of the teaching/learning process yields rewards for both learners and teachers, as well as the wider academic fraternity.

The use of a group 'real-life' project under tight time limits and the pressures they exert proves to be very rewarding for the students. They find the experience both frustrating and rewarding – a reflection of reality. The group project manages to bring forth all the management elements we would like to emphasise: group formation, conflict, motivation, leadership, negotiation, criticism, cooperation.

The planning of personal and group portfolios help to emphasise the project planning, communication and presentational skills. Product development or business planning brings to the fore the knowledge required for

brainstorming novel ideas, divergent and convergent thinking skills, incubation (reflection), evaluation of solutions and finally verification.

Students have an intrinsic desire to learn and they learn more effectively if they believe that what they are being taught will matter in their lives [6, 7, and 8]. The programme, in its latest iteration, is to introduce more interactive presentations and mixed-team learning activities with a competitive element dispersed throughout the modules, culminating with short, 5 minute group presentations to peers and staff. Emotions are known to have a strong, some say dramatic, impact on learning [6]. The use of group case presentations in front of judges outside their 'comfort zone' raises the stakes as does the element of inter group competition. The emphasis here is on teamwork, integrity and dedication. Motivation and pleasure are the basic ingredients here; there are intrinsic rewards associated with the learning process itself but the intention is to also introduce extrinsic rewards (e.g. prizes) in the future.

Finally the assessment process provides the students with ample opportunities to express their learning in a creative non-prescriptive manner by allowing them freedom of expression. The personal portfolios are exactly what the title states 'personal'. Although all students are given instructions as to what areas their portfolios should cover, each portfolio is different, reflecting the individuality of its owner. That sometimes creates problems for the 'external' examiners who would like to see more uniformity and clearly identifiable scoring scales, but after all these are modules on creativity and creativity is not uniform, it is chaotic. Another useful part of the assessment exercise is that of the students having to assess each other and providing the reasons for their choices. This is a test of what behavioural and ethical skills and awareness the module has imparted. The intention of these modules is to instil new mindsets in the students cultivating fondness for creativity and learning, in addition to building up their confidence, enthusiasm and abilities to communicate and collaborate effectively with others.

For future developments what we would like to be able to do would be more systematic analyses of the learning style and thinking style indicators data by using them at the beginning and at the end of the course and looking for any significant shifts in the patterns, as well as combining them with questionnaires of pre- and post-course surveys about the modules. Such data will provide indications as to any gains derived by the students as well as useful information on any learning pattern alterations.

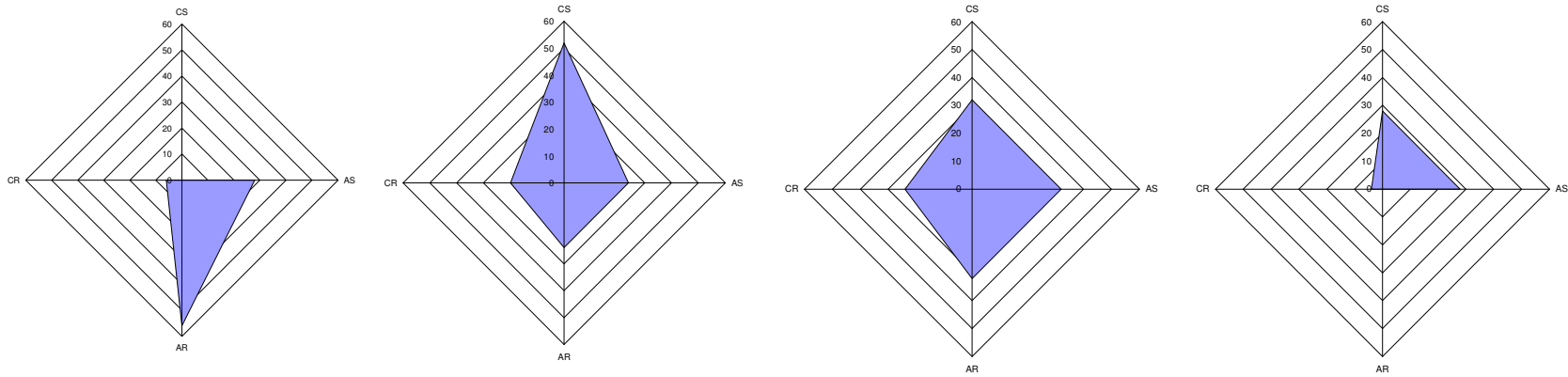
"The role of the teacher is to provoke capacity in the student, to provide what there is when it will be useful, to guide him towards progress. It is not to impress, to give an impression of virtue, power, importance, knowledge or anything else".

From: Learning how to learn, Idries Shah.

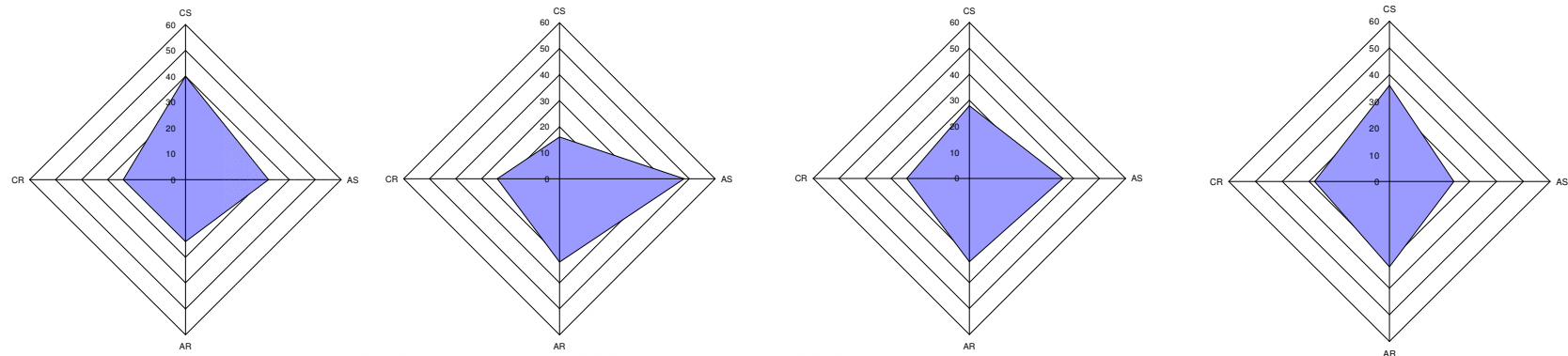
REFERENCES

1. P. Kapranos, 21st century Teaching & Learning - *Kolb Cycle & Reflective Thinking as part of teaching, Creativity, Innovation, Enterprise and Ethics to Engineers*, Proceedings of ISEE-07, International Symposium for Engineering Education, Sep. 17-19th 2007, Dublin City University, Ireland, Editors Dermot Brabazon & Abdul Ghani Olabi, pp 3-11
2. I B Myers and M H McCaulley, Manual: A guide to the Development and use of the Myers-Briggs Type Indicator, Consulting Psychologists Press, Palo Alto, CA, 1985.
3. <http://agelesslearner.com/assess/learningstyle.html>
4. W. G. Perry Jr., Forms of Intellectual and Ethical Development in the College Years, Holt, Rinehart and Winston, Inc., NY, 1970.
5. P.M. King and K.S. Kitchener, Developing Reflective Judgment, Jossey-Bass Publishers, San Francisco, 1994.
6. J. Zull, The Art of Changing the Brain: Enriching the Practice of Teaching by Exploring the Biology of Learning, VA: Stylus Publishing, LLC, Sterling, 2002
7. L.S. Lumsden, Student Motivation to Learn, in ERIC Clearinghouse on Educational Management, Eugene, OR, 1994
8. S.B. Nolen, Learning environment, motivation and achievement in high school science, Journal of Research in Science Teaching, 2003, 40 (4), pp 347-368

Realist



Experimenter



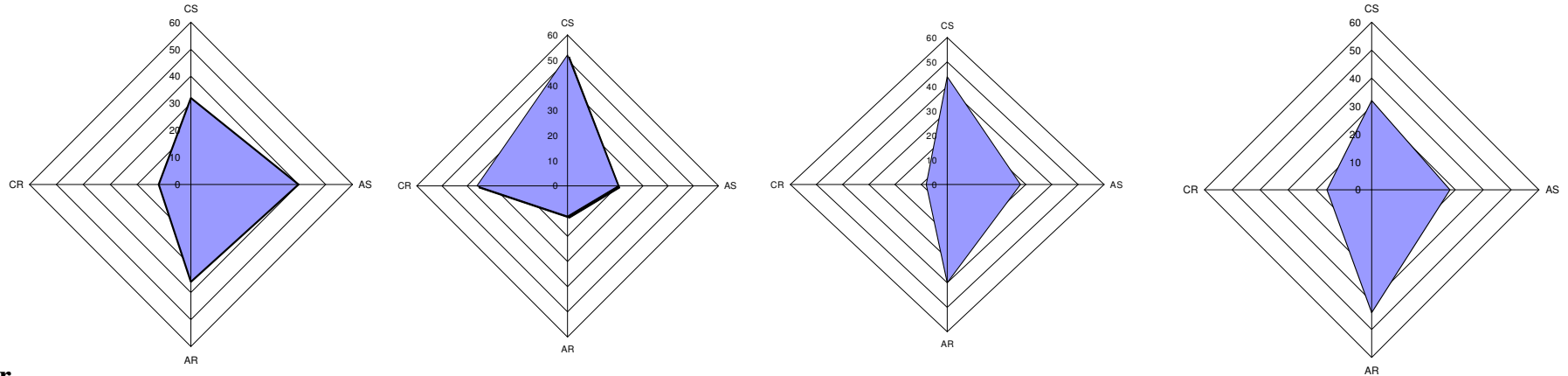
Theorist

Reflector

CS – Realists, **CR** – Experimenters, **AR** – Reflectors & **AS** - Theorists

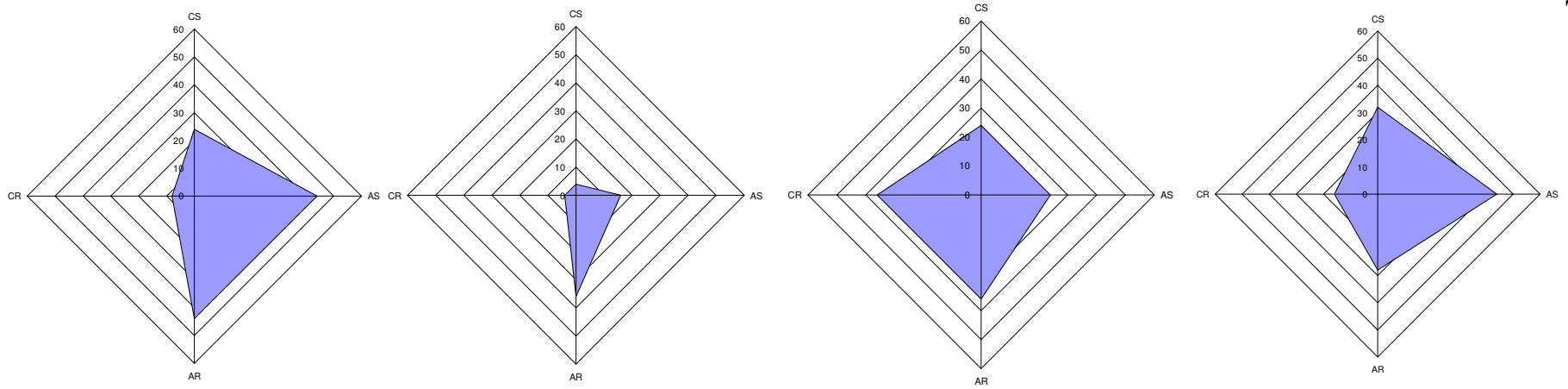
Realist

PK's thinking style



Experimenter

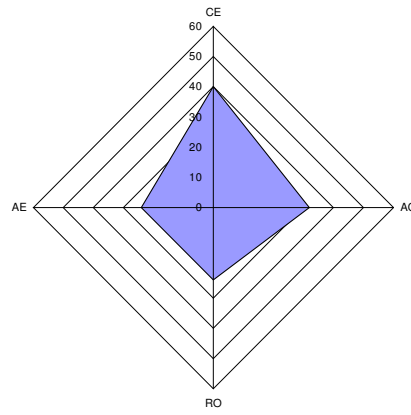
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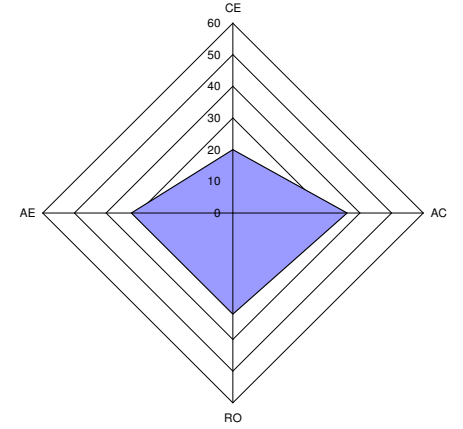
Reflector

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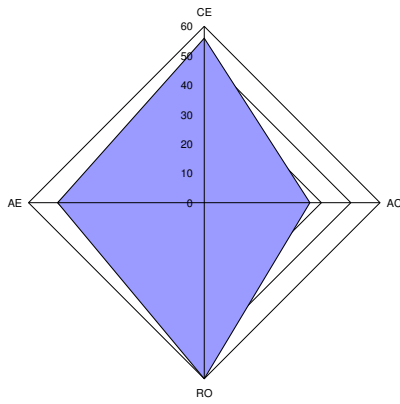
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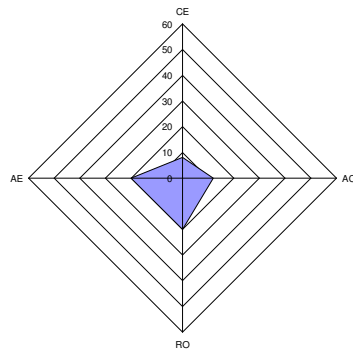
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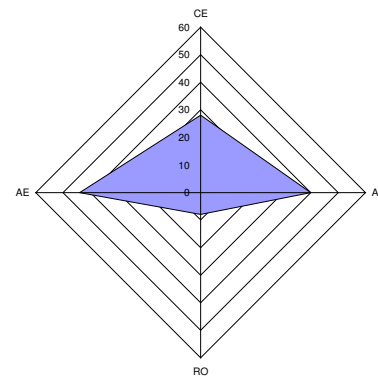
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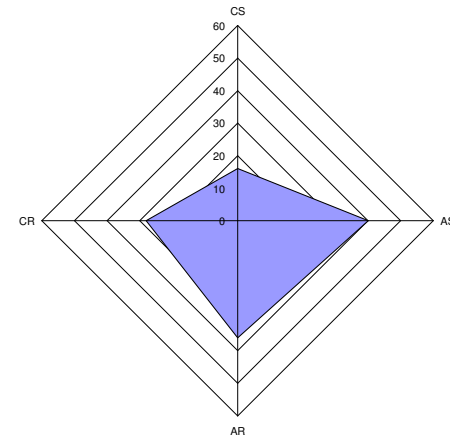
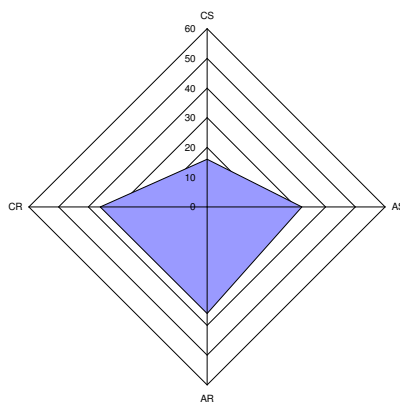
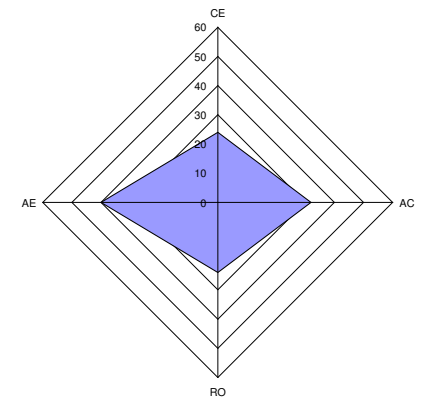
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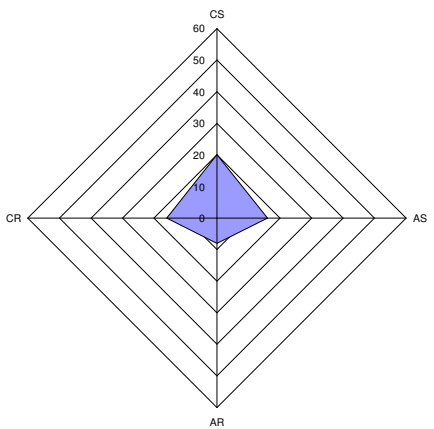
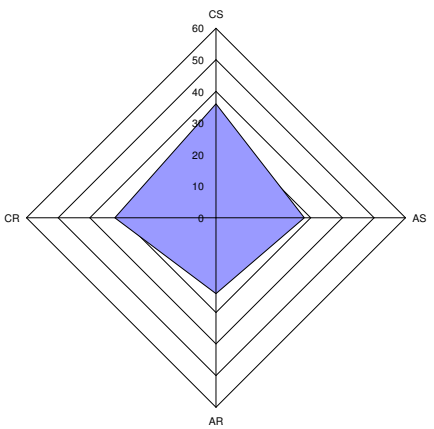
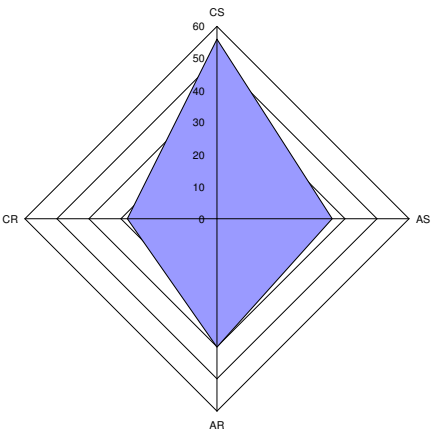
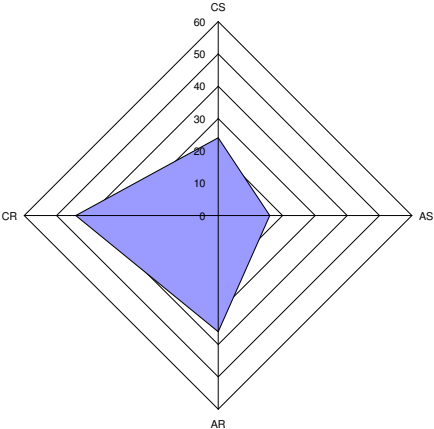
Hemraj



Mak



Realist

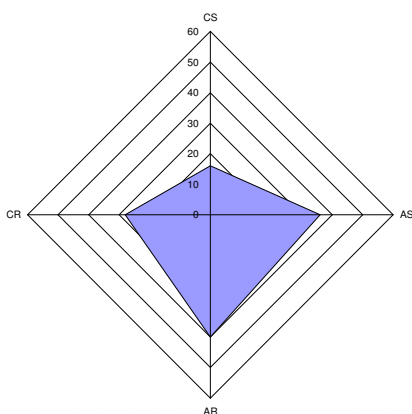
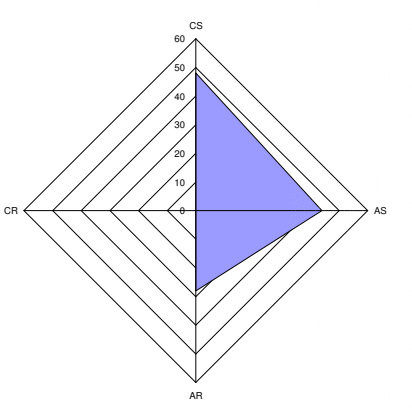
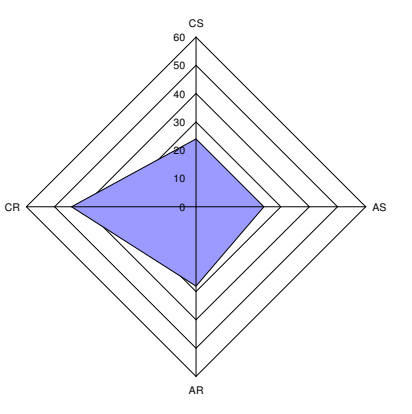
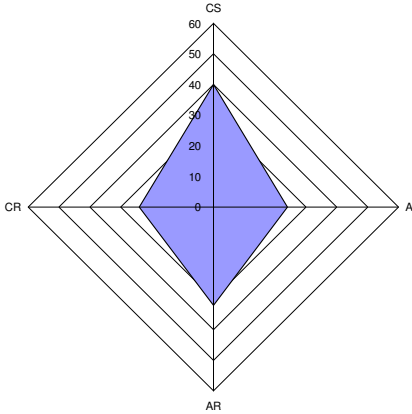


Experimenter

Theorist

Henderson

Brown



Reflector

CS – Realists, **CR** – Experimenters, **AR** – Reflectors & **AS** - Theorists

