Policy in Respond to COVID-19 School Closure

Learning Loss among Primary School Students in the Netherlands

Abstract

Since 2020, COVID-19 driven school closures have caused profound disruption in education worldwide. Engzell, Frey and Verhagen (2020) reveal a learning loss of about 3 percentile points from a study involving primary school students in the Netherlands.

Burguss (2020) as well as Donelly and Patrinos (2020) claimed that research has shown that 12-week programs of small group tutoring can result in progress that would be expected from three to five months of normal schooling. In this model, the policy introduces National Learning Recovery Program (NLRP), a small-group tutoring approach to be implemented in the Netherlands to reduce and reverse learning loss among primary school students.

The interface explores policy and its implementation obstacles to reduce and reverse learning loss among primary school students. Overall impact of tutoring policy relies not only on supply of tutors and the students who participate tutoring, but also on the monitoring and communication of that policy. Taking into implementation challenges at the ground level, the model shows that student motivation, teacher, parents, tutors communication, and implementation cost can turn small changes into big difference in the overall impact of the policy.

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1. Dynamic Problem

COVID-19 driven school closures have caused profound disruption in education worldwide. In the Netherlands the schools closed for an eight-week period starting in March 2020. Engzell, Frey and Verhagen (2020) reveal a learning loss[1] of about 3 percentile points from a study involving 350,000 primary school students in the Netherlands. The average learning loss is equivalent to a fifth of a school year, nearly exactly the same period that schools remained closed.

Estimates suggest that if a student loses about a third of a school year of learning, this is associated with an income loss of about 3% on average over the entire working life (Hanushek and Woessmann 2020). The effect could seem mild now. However, this will be reflected in the economic potential of a country starting from the mid-2030s. A simulation study by World Bank (2020) shows that this generation of students is bound to lose at least US$ 10 trillion in foregone future earnings globally.

Objective

In 2020, the Dutch government has shown a willingness to invest in education with multiple contributions totalling to approximately 500 million euros to combat learning loss (Rijksoverheid, 2020). Therefore, the proposed policy is politically and bureaucratically feasible. The main challenge lies in making an effective policy that takes implementation obstacles in consideration within the policy design.

This policy model and a Stella based interactive learning environment offer a system perspective on the problem. The interface explores the policy and its implementation obstacles to reduce and reverse learning loss among primary school students in the Netherlands.

[1] All of the academic skills will decay over time if it's not used on a daily basis. Learning loss refers to “any specific or general loss of knowledge and skills or reversals in academic progress, most commonly due to extended gaps in a student’s education” (Huong and Jatturas, 2020).

2. Policy Proposal

Focusing on the Netherlands, this model suggests a way to repair some of the learning loss using small group tutoring, a method with widely proven effectiveness, at a modest cost, and on a rapid but feasible timescale.

Burguss (2020) as well as Donelly and Patrinos (2020) claimed that research has shown that 12-week programs of small group tutoring can result in progress that would be expected from three to five months of normal schooling. In this model, the policy introduces National Learning Recovery Program (NLRP), a small-group tutoring approach.

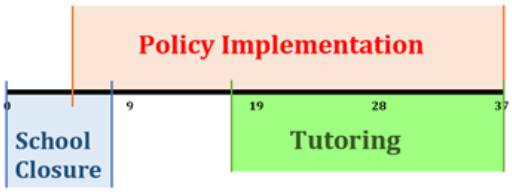
Implementing a nationwide tutoring system under significant time pressure is challenging; it requires recruiting and training a large number of tutors. Therefore, the NLRP will adopt a "platform service" approach by collaborating with qualified tutoring organizations to meet these challenges.

The platform allows clients (schools) to be matched with suppliers (tutoring organizations) with a standardized tutoring fee supported by the NLRP allocated budget. School teachers who want to be part of the NLRP as tutors can register on the platform.

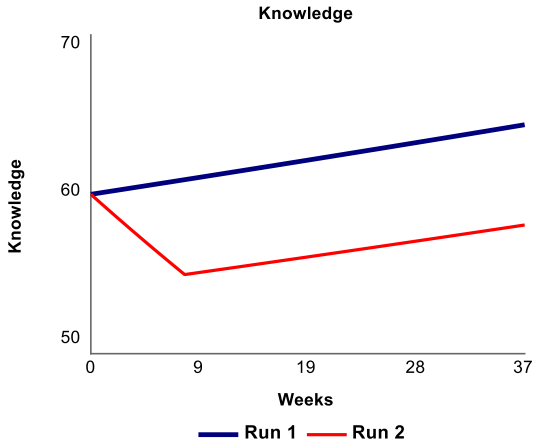
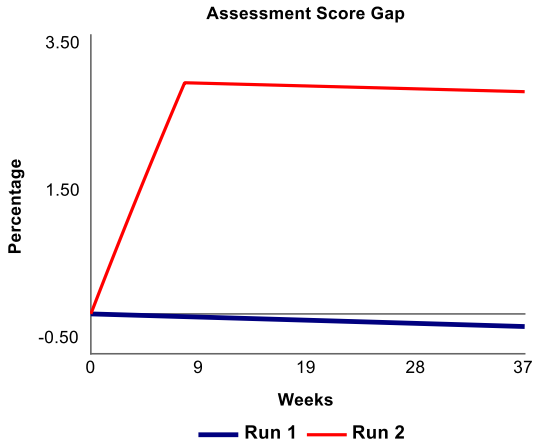
Overall, tutoring occurs after school hours and can be online or in-person, depending on the COVID-19 regulations. Any student who is interested can get access to daily tutoring session (30 minutes) for 20 weeks. Teachers will encourage students who are impacted by the school closures to join the NLRP as recommended by Engzell et al. (2020). Teachers will also monitor and evaluate the progress of the tutoring.

Timeline

The present policy design model is developed with the aim to inform the government in responding to the pressing problem of learning loss immediately. Therefore, the model is built after the announcement of the school closures (ahead of the actual school closures) to inform policy making. It is assumed that the policy is approved by all legislative and executive bodies of the government during week 0-5. The NLRP is initiated in week 6 and ends in week 37. The implementation committee, Monitoring Evaluation Learning (MEL) Framework, and the tutoring platform are formed from week 6 to 11. Next, the tutor hiring, student registration and matching process starts from week 11 to 17. The tutoring then begins on week 17 to 37.



3. Results

<table>
<tr><td rowspan="2">Results</td><td colspan="2">Academic Learning</td></tr>
<tr><td>School as Usual - Run 1</td><td>School Closed – Run 2</td></tr>
<tr><td>Knowledge</td><td colspan="2"> 
</td></tr>
<tr><td rowspan="2">Assessment Score Gap</td><td colspan="2"> 
</td></tr>
<tr><td>Run 1: -0.16%</td><td>Run 2: 2.79%</td></tr>
<tr><td>Behaviour Analysis</td><td colspan="2">Run 1 shows how knowledge would progress under normal learning conditions without COVID-19 school closures. The knowledge level continues to grow throughout the school year. Run 2 portrays the learning loss problem where the knowledge decay (outflow of knowledge) is more than knowledge increase (learning). The knowledge level decreases significantly only to recover once the schools reopens.

The assessment score gap is a gap that compares the average academic scores of students to the current scores. As can be seen, this gap increases considerably during the school closure. As the knowledge level of the students increases again after school reopens, the assessment score gap decreases slightly.</td></tr>
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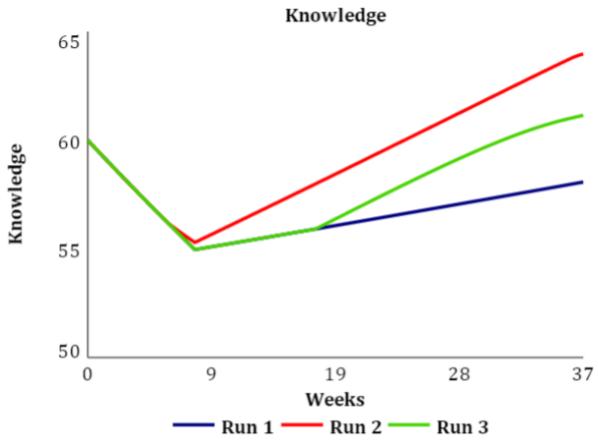
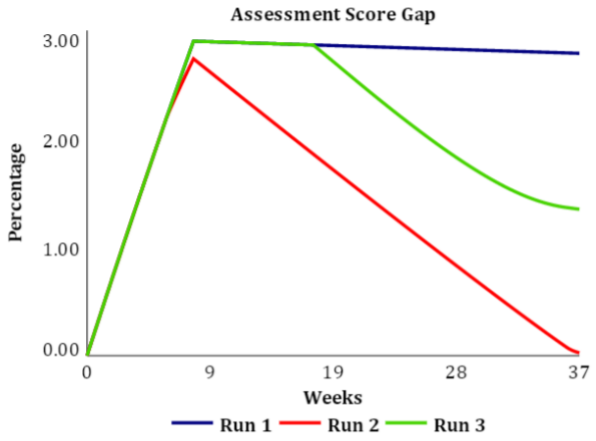
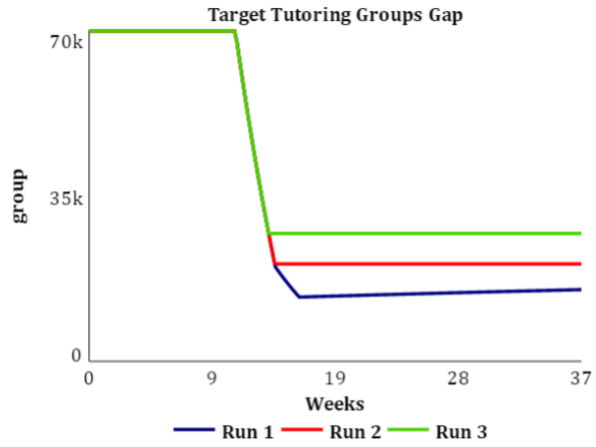
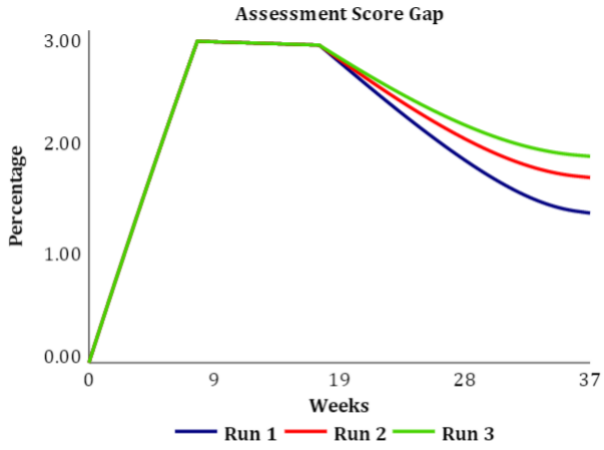
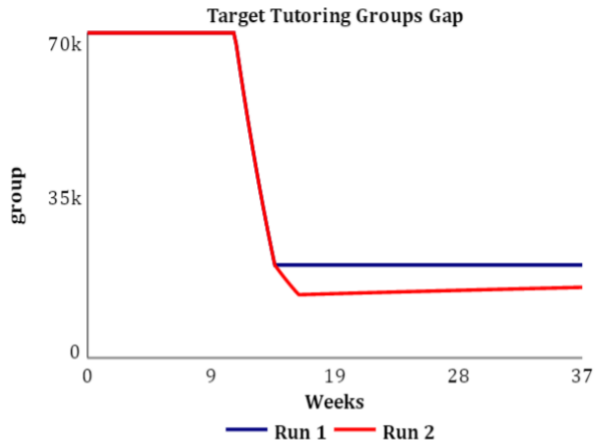
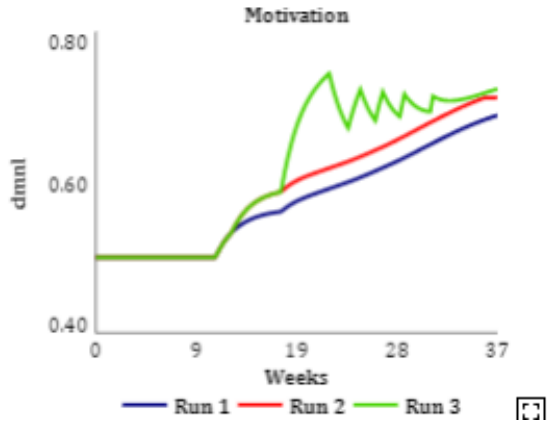
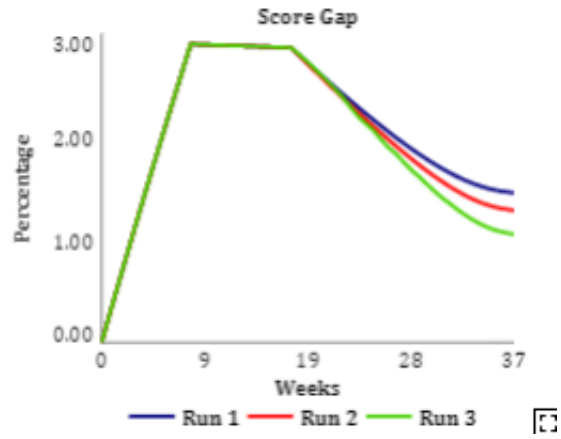
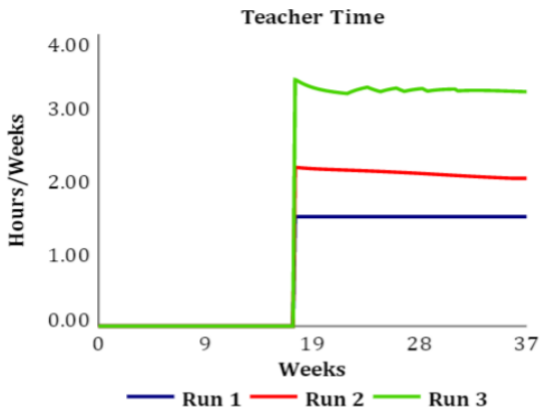
Results	Academic Learning		
	Without Policy - Run 1	Wishful Thinking – Run 2	With Policy - Run 3
Knowledge			
Assessment Score Gap			
	Run 1: 2.79%	Run 2: 0.03%	Run 3: 1.35%
Behaviour Analysis	In the most optimistic scenario – wishful thinking scenario – the knowledge gap would be closed completely after the policy implementation. Run 3 result illustrate a slight decline from week 9 to week 19 that is contributed by the students returning to school as usual. In the same period, the policy is in the initiation and planning phase. The tutoring program then starts in week 17, and the effect of tutoring only begins to cause a decline in assessment score gap from week 19 onwards. This is because it takes time for knowledge to accumulate/increase.		

Results	Funding		
	100% - Run 1	70% – Run 2	50% - Run 3
Target Tutoring Groups Gap			
Assessment Score Gap			
	Run 1: 1.35%	Run 2: 1.67%	Run 3: 1.86%
Behaviour Analysis	The model includes three different funding scenarios where the desired funding is approved for 100%, for 70% and 50%. The amount of approved funding affects the number of tutors. The less tutors employed, the less impact the policy has. The graphs above portray how the variable *target tutoring groups gap* behaves in the different scenarios. This variable shows the gap between the desired tutoring groups and the actual tutoring groups. The closer the actual tutoring group to the desired tutoring group, the more significant impact it contributes to the decline of assessment score gap.		

Base Setting	School Closure, Funding 100%	
Results	Tutor Supply	
	Without Plan B - Run 1	With Plan B – Run 2
Target Tutoring Groups Gap		
Assessment Score Gap		
	Run 1: 1.65%	Run 2: 1.35%
Behaviour Analysis	Another factor that influences the success of the program is the supply of tutors. NLRP will employ tutors from already existing tutoring agencies that qualify for the program and they will employ school teachers that sign up to the program. However, depending on student demand, this may not be enough. In the case that there are not enough tutors available to keep up with student demand, a Plan B policy can be set in motion. When Plan B is put in action, a call for application will also be send out to other individuals that could possibly qualify to become a tutor in the program (if the budget allows it). For example, recently retired tutors or university students who are studying in the pedagogical field. The graphs above show the impact Plan B on closing the target tutoring group gap (closer to the target), assuming 100% of the desired funding is approved.	

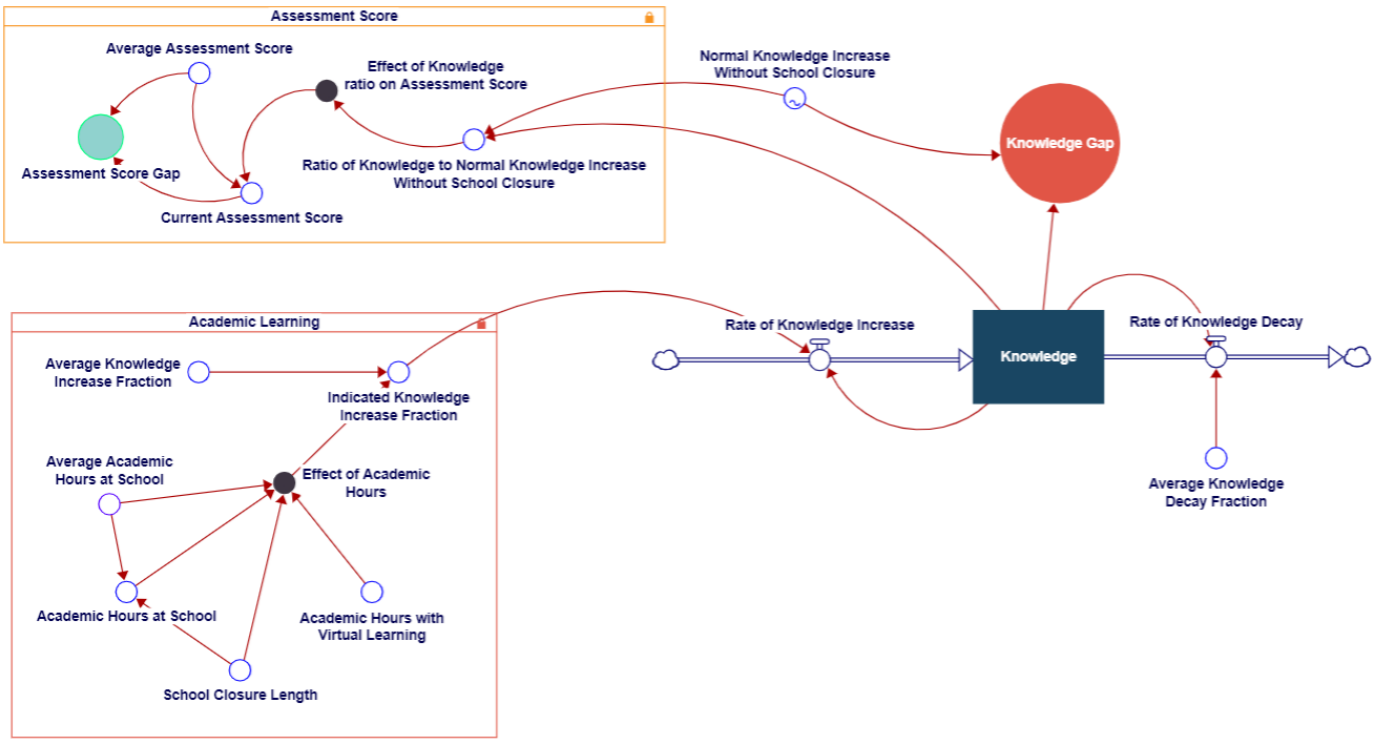
Base Setting	School Closure, Funding 100%, with Plan B		
Results	Teacher Monitoring and Communication		
	Minimal time for Students and Parents - Run 1	More time for Students and Parents – Run 2	More time for Tutors - Run 3
Student Motivation			
Assessment Score Gap			
	Run 1: 1.35%	Run 2: 1.28%	Run 3: 1.05%
Teacher Total Time Spent			

Behaviour Analysis	Student motivation initially influences how many students sign up for the program. Once the tutoring sessions have begun, student motivation will also influence the effectiveness of the program. If the motivation is high, the student will likely spend more time on their academic progress, thus affecting the knowledge accordingly. To influence motivation, two different policy options are identified. As a short-term option, when the teacher notices that the registrations are not as high as desired, the teacher will allocate extra communication time with the students and the parents to encourage registration to the NLRP (Run 2). Run 2 shows a higher increase rate of motivation from week 11 during the student registration period). The other policy option is a mid-term strategy for increasing the student motivation level once the tutoring sessions have already begun. The teacher communicates their knowledge about the lack of motivation to the tutor who in turn will ensure to spend more time building student engagement during the tutoring sessions instead of merely focusing on academic progress (Run 3). Both these strategies are represented in the graphs above as well as a comparison run when neither of the strategies are implemented. As can be seen, the most favourable scenario is Run 3. In the graph portraying student motivation, it can be seen that the behaviour of Run 3 does not increase smoothly, but is oscillating instead. This behaviour occurs because the strategy depends on the current student motivation level. When the strategy is active, the teacher communicates the student needs (either focused on engagement or academic progress) to the tutor depending on the motivation level. After the engagement approach increases motivation, the tutor changes the approach to academic focus. Over time, the motivation decreases. With the delay in teacher perception of student motivation, the teacher and tutor take time to respond to the student motivation, causing the oscillation. However, the oscillations stops eventually when the motivation is sustained by student's own intrinsic motivation. When looking at the last graph comparing teacher time per strategy, it can be seen that Run 3 requires the most extra time. This is because good communication with the tutor does not only include the time actually communicating with the tutor, but also the time it takes for the teacher to monitor the behaviour and progress of the students.

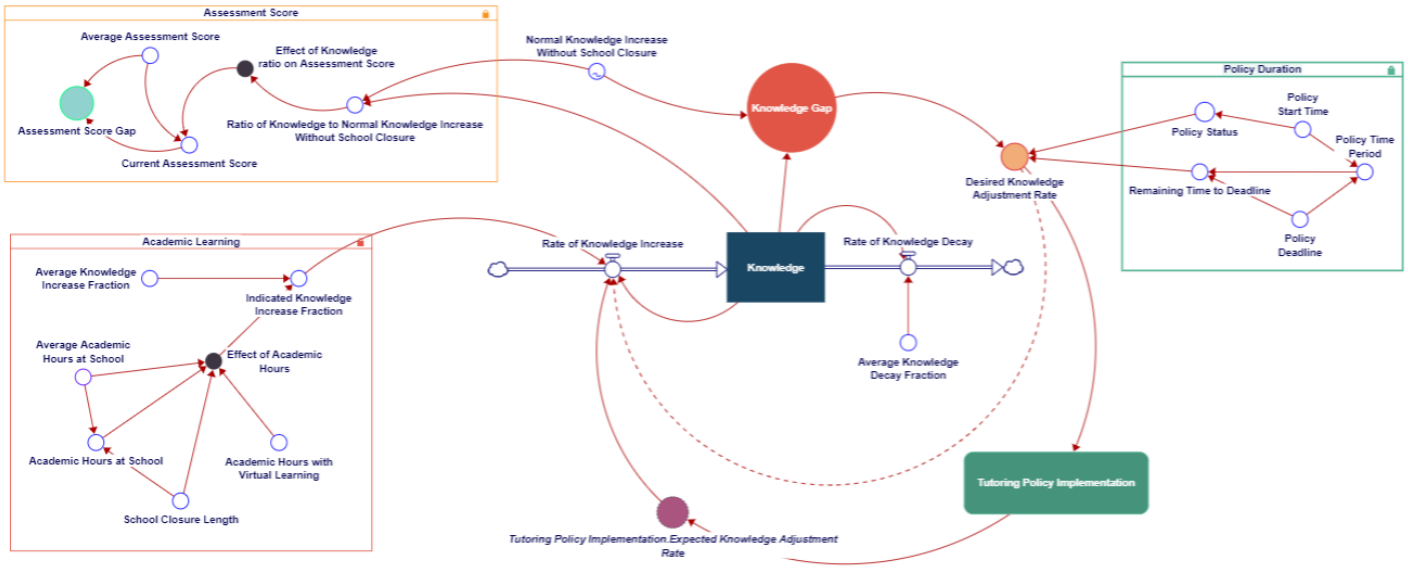
5. Implementation Sub-Model

5.0 Explanatory Model

The figure below shows the part of the model that explains the knowledge gap that occurs due to the COVID-19 school closures. The stock knowledge influences the current assessment score (the grades) of the students which is compared to an average assessment score. When subtracting the current score from the average score, the assessment score gap can be determined. In addition to an assessment score gap, there is a knowledge gap. The behaviour of the knowledge stock is subtracted from as estimated behaviour of knowledge under normal conditions.



The intention of the policy is to close this knowledge gap. The desired knowledge adjustment rate is a variable that shows the level of knowledge that has to be gained back each week to close this gap before the end of the NLRP. By adding this to the inflow *rate of knowledge increase* a wishful thinking link is created. To determine a more realistic scenario, a sub-model is introduced that takes various influences on the policy in consideration. Eventually the sub-model produces a variable *expected knowledge adjustment rate,* which is added to the inflow instead of the *desired knowledge rate.*

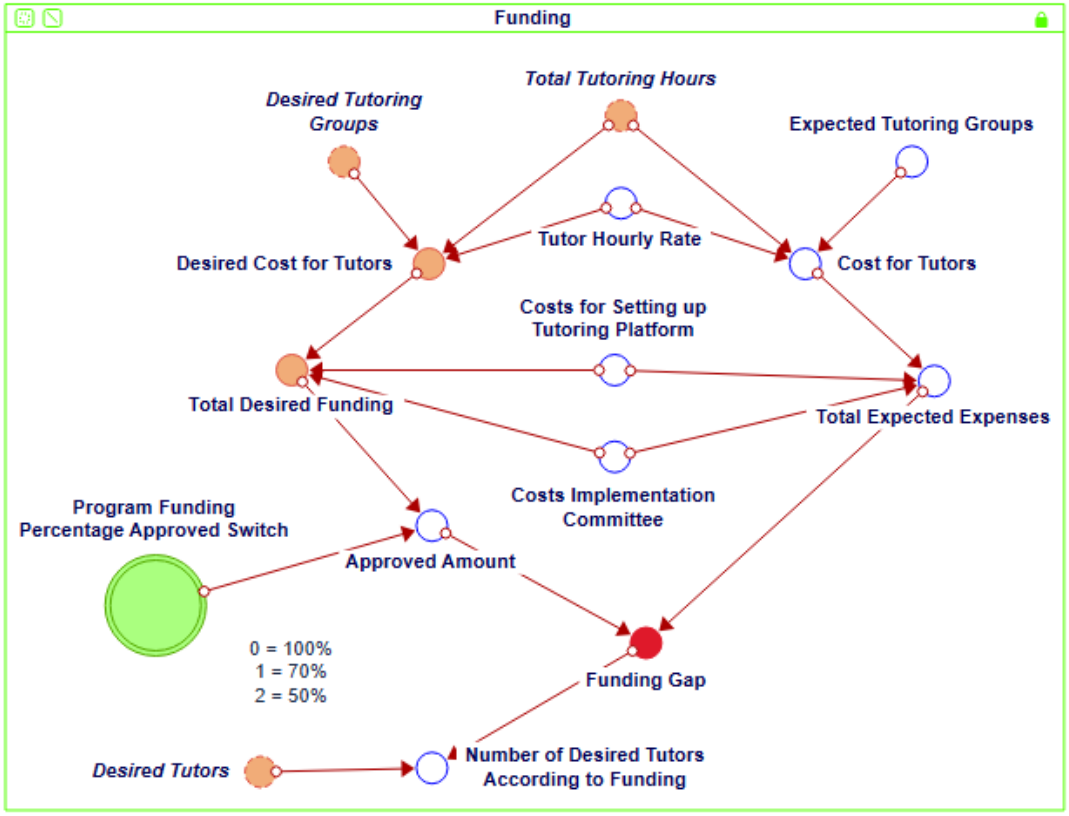


The following chapters will discuss the most important factors that influence the *expected knowledge adjustment rate* either directly or indirectly.

5.1 First Implementation Obstacle

5.1.1 Funding

The figure below shows the desired funding on the left side and the expected expenses on the right.



The desired tutoring groups is derived from the desired knowledge adjustment rate. The total tutoring hours on the top is a fixed number of hours, 2.5 hours a week multiplied with 20 weeks. By multiplying the desired tutoring groups with the total tutoring hours and the tutor hourly rate, the total desired costs for tutors are found. The fixed costs of setting up the tutoring platform and the implementation committee combined with the desired costs for tutors provides the total desired funding.

The expected tutoring groups which are derived from the variable *matched tutoring groups* is used to calculate the total expected expenses. To get the value of the funding gap, the total expected expenses is subtracted from the approved amount. The funding gap then determines the *number of desired tutors according to funding* as per the equation below:

```
Number_of_Desired_Tutors_According_to_Funding =
IF Funding_Gap>0 THEN Desired_Tutors ELSE IF Funding_Gap>-6000000 AND Funding_Gap<-3000000
THEN Desired_Tutors*0.7 ELSE IF Funding_Gap<-10000000 AND Funding_Gap>-20000000 THEN
Desired_Tutors*0.6 ELSE 0
```

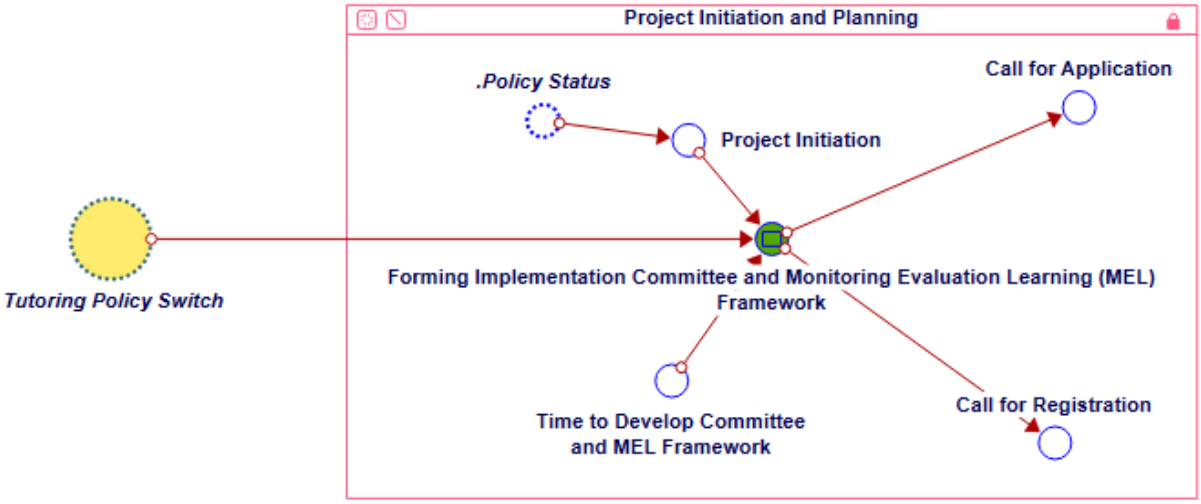
5.1.2. Project Initiation

The entirety of the school system in the Netherlands is a national government function. However, the implementation of the NLRP largely takes place on a local level. To ensure that the program runs smoothly an implementation committee is formed in the first two months after the policy start time. This committee will be responsible for setting up the NLRP. Throughout the entire policy duration, the committee will provide assistance to all stakeholders.

If the Tutoring Policy and a budget has been approved, the implementation committee and the MEL framework can be formed. It is assumed that there is a delay of 6 weeks to get these preparations done. As there is a strict time pressure to start the tutoring sessions it is assumed that this deadline is met, which is why it is divided by three as per the below equation.

```
Forming_Implementation_Committee_and_Monitoring_Evaluation_Learning_(MEL)_Framework =
IF .Tutoring_Policy_Switch=2 THEN DELAYN(Project_Initiation,
Time_to_Develop_Committee_and_MEL_Framework/3, 3, 0) ELSE 0
```

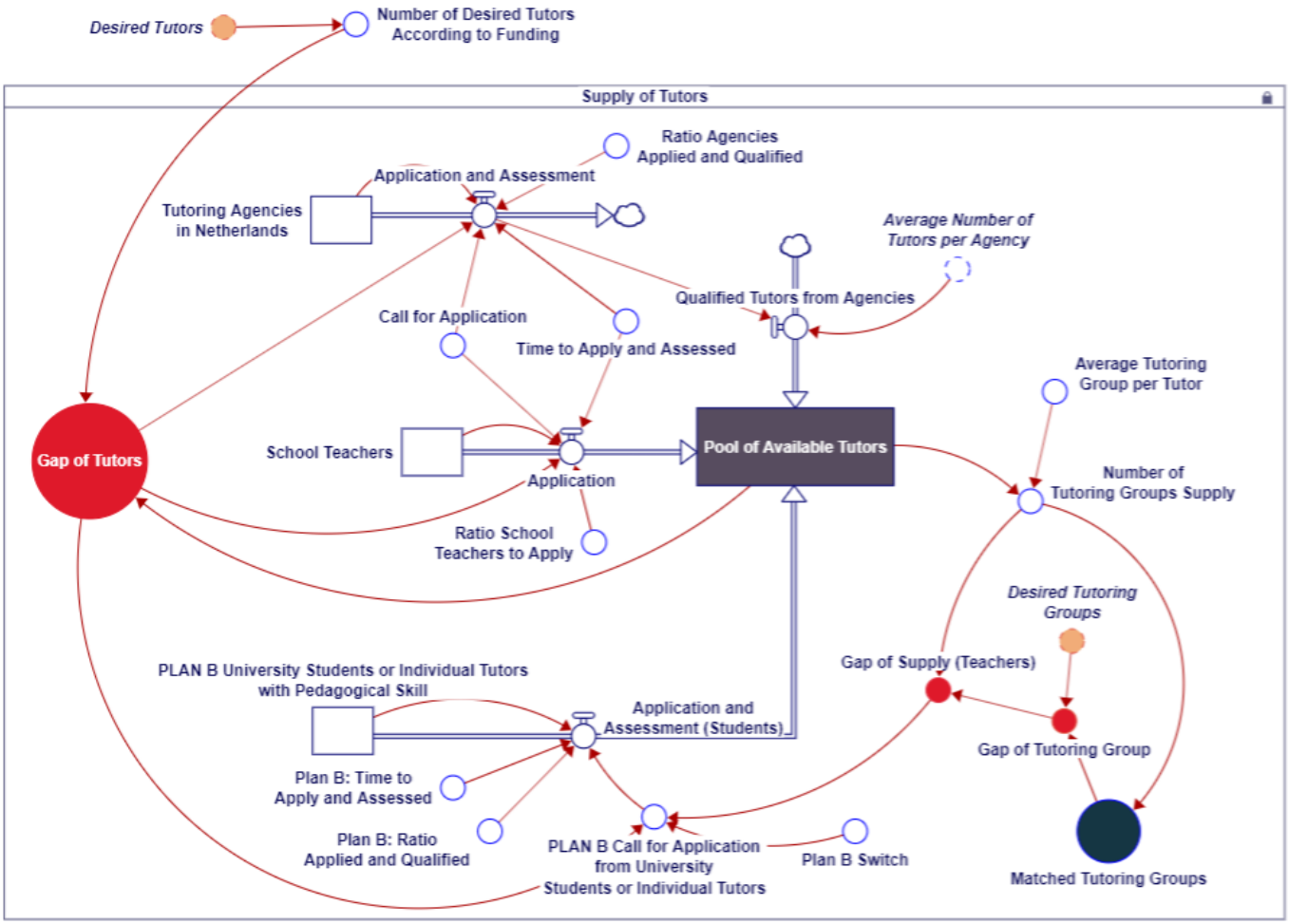
When the framework is finalized, the committee will open the registrations to join the NLRP for both the students and the tutoring agencies.



5.2 Second Implementation Obstacle

5.2.1. Tutor Supply

The tutor supply sector in the figure below determines how many tutors are hired.



To ensure that the tutors hired for the program meet the quality standard set by the government, all tutoring agencies will go through a selection process through an application inflow. The *number of desired tutors according to funding* feeds into the tutor gap, which is the gap between that variable and the stock pool of available tutors. This tutor gap in turn influences the inflow of tutors from the three different stocks. Below the equation of the inflow *application and assessment:*

```
IF Call_for_Application=1 THEN IF Gap_of_Tutors>0 THEN
Tutoring_Agencies_in_Netherlands*Ratio_Agencies_Applied_and_Qualified/Time_to_Apply_and_Assessed
ELSE 0 ELSE 0
```

This equation indicates that when the call for application has been done and is active, and while at the same time there are still tutors needed (when gap of tutors is bigger than 0), then the tutoring agencies are multiplied with the assumed ratio of qualified agencies that apply. It was assumed that these agencies would qualify to join NLRP with a ratio of 0.6. As it takes a bit of time to approve these agencies, it is also divided by that assessment time.

Additionally, there is an opportunity for school teachers to sign up for the program. The inflow coming from the stock of *School Teachers* has a similar equation. As these teachers are already qualified, they will automatically

be accepted as qualified tutors for the program. It has been assumed that the ratio of school teachers applying to be a tutor in the program is 0.2.

Both inflows end up in the stock *Pool of Available Tutors.* Going from this stock, there is a structure on the right that determines if there is a gap of tutor supply. The stock of available tutors determines how many tutoring groups they can supply given that each tutor can give tutoring sessions to 3 groups. The *matched tutoring groups* (the actual number of tutoring groups that are active in the program) is the lowest value between this supply of tutoring groups, or the student demand for groups (chapter 5.3.1). The actual matched tutoring groups compared to the desired tutoring groups provides the value of the gap of supply.

When there is a gap of supply, and when the budget allows it, the Plan B switch can be activated so more tutors can be hired. The variable *PLAN B Call for Application from University Students or Individual Tutors,* is only activated when there is a big enough gap of tutors compared to the desired amount that the budget can hire *and* a gap between student demand and supply:

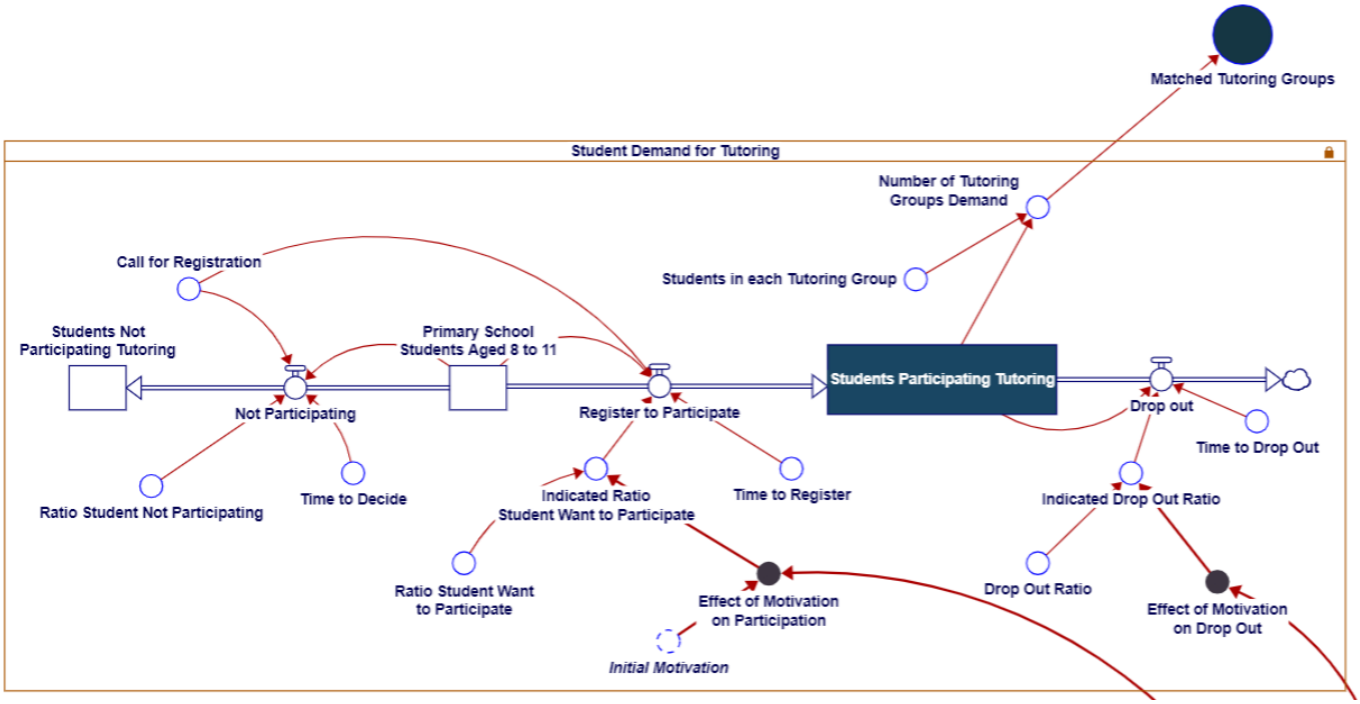
```
IF Plan_B_Switch=0 THEN 0 ELSE IF Gap_of_Tutors>-100 THEN IF "Gap_of_Supply_(Teachers)"=1
THEN STEP(1, 14) + STEP(-1, 17) ELSE 0 ELSE 0
```

When only 50% of the desired funding is approved, there is no room in the budget to hire any Plan B tutors.

5.3 Third Implementation Obstacle

5.3.1. Student Demand

To ensure that the program is as effective as possible, it must be an attractive option for the students as joining the NLRP is voluntary.



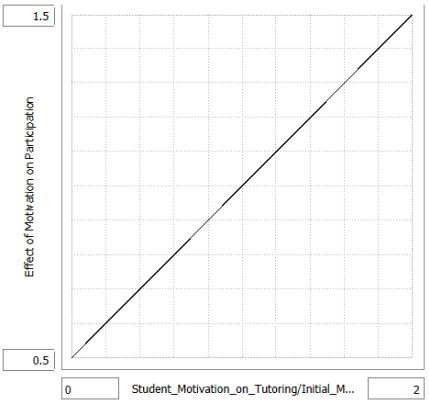
In the upper left side of the structure the variable *call for registration* is visible (equation below). This variable is active when the MEL framework is 90% formed and will stay active for 3 weeks.

```
IF
"Forming_Implementation_Committee_and_Monitoring_Evaluation_Learning_(MEL)_
Framework">0.9 THEN STEP(1, 11) + STEP(-1, 14) ELSE 0
```

When the registrations are open the variable is multiplied with both outflows of the stock *primary school students aged 8-11.* This stock contains all the students from our target group and when registrations are open, they can move to the stock of *students not participating tutoring* or to the stock *students participating tutoring.* Below is the equation of the outflow of the students who decide not to participate. When registrations are open, the stock is multiplied with the ratio of students that do not want to apply, divided over the time it takes them to decide.

```
IF Call_for_Registration=1 THEN
Primary_School_Students_Aged_8_to_11*Ratio_Student_Not_Participating/
Time_to_Decide ELSE 0
```

The outflow containing students who do want to participate follows a similar equation. The difference is that the *indicated ratio student who want to participate* is not a constant variable but can be affected by the student's motivation to join the program (chapter 5.3.2) through the use of a table function as seen on the right.



From the stock *students participating in tutoring* there is another outflow that represents the students that will drop out of the program. The equation of that outflow is as follows:

```
Students_Participating_Tutoring*Indicated_Drop_Out_Ratio/Time_to_Drop_Out
```

Here again, the *indicated drop out ratio* is affected by the motivation level of the students. Only this time motivation negatively influences the ratio.

Finally, from the pool of students who are registered to join the program, the demand of tutoring groups can be determined and the tutors can be matched to the groups.

5.3.2. Student Motivation

The model takes both extrinsic and intrinsic motivation in consideration. At the top of the figure below the effect variables on student demand can be seen.

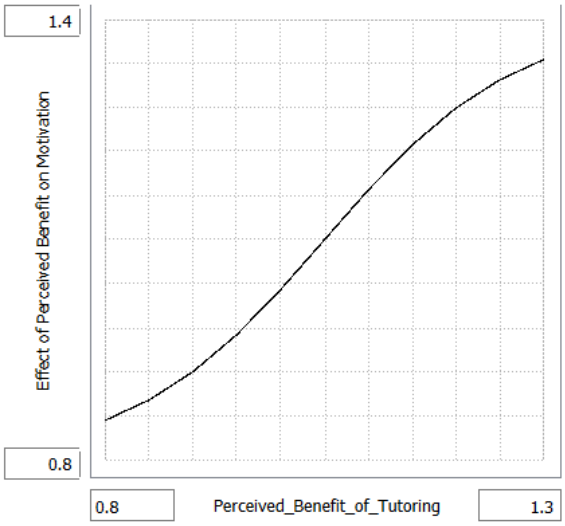
The variable in red, *gap between desired and current motivation,* is found by subtracting the current motivation from the desired. This gap variable influences different other sections of the model. Most notably teacher and parent communication with the student and the tutoring approach regarding student engagement. More on this in the upcoming chapters.

The variables at the bottom of the figure represent the intrinsic motivation of the student. The variable *effect of reduced leisure time* negatively influences the *perceived benefit of tutoring* whilst the *effect of perceived improvement* positively influences it.

The perceived benefits of tutoring in turn positively influences motivation through the table function *effect of perceived benefit on motivation* that can be seen on the left.

The effects of communication, student-engagement and intrinsic motivation are all multiplied with a variable *initial motivation* (assumed to be 0.5) to get the variable *indicated motivation.*

This variable *indicated motivation* then leads to the inflow *change in motivation* which has the below equation.

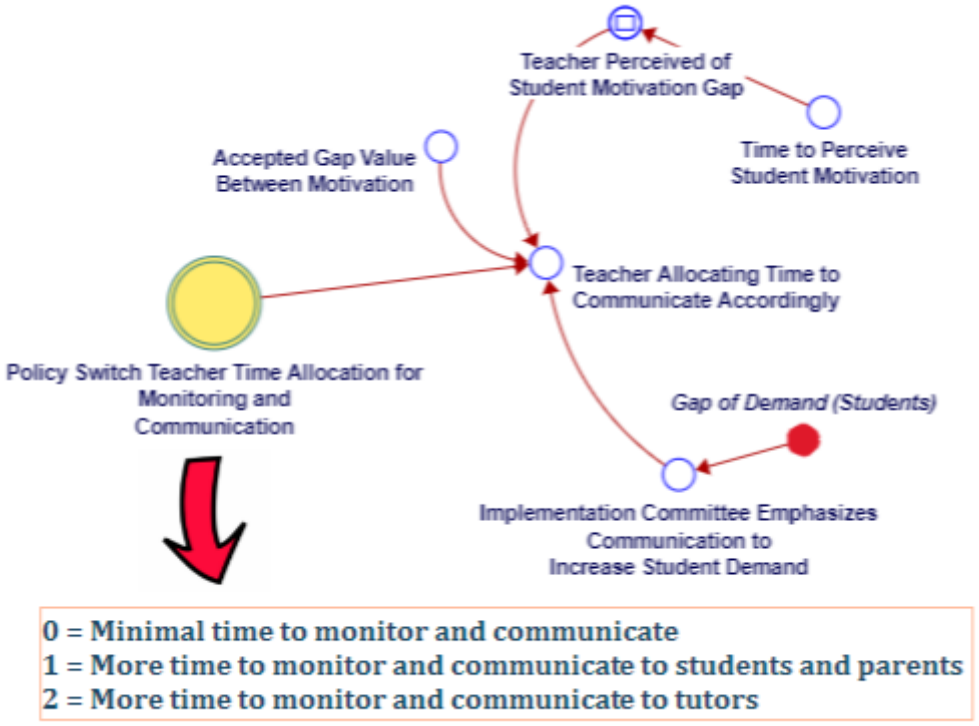


Change_of_Motivation = A

```
IF .Tutoring_Policy_Switch=0 AND Call_for_Registration_Start=0 THEN 0
ELSE IF .Tutoring_Policy_Switch=2 AND Call_for_Registration_Start=1 THEN
MIN(1,  (Indicated_Motivation-Student_Motivation_on_Tutoring)/
Motivation_Adjustment_Time) ELSE 0
```

5.3.3. Teacher Perception and Communication

The gap between desired and current motivation, as discussed in the previous chapter, is an indication for the teachers to spend more time communicating with the parents and students to try and increase that motivation.



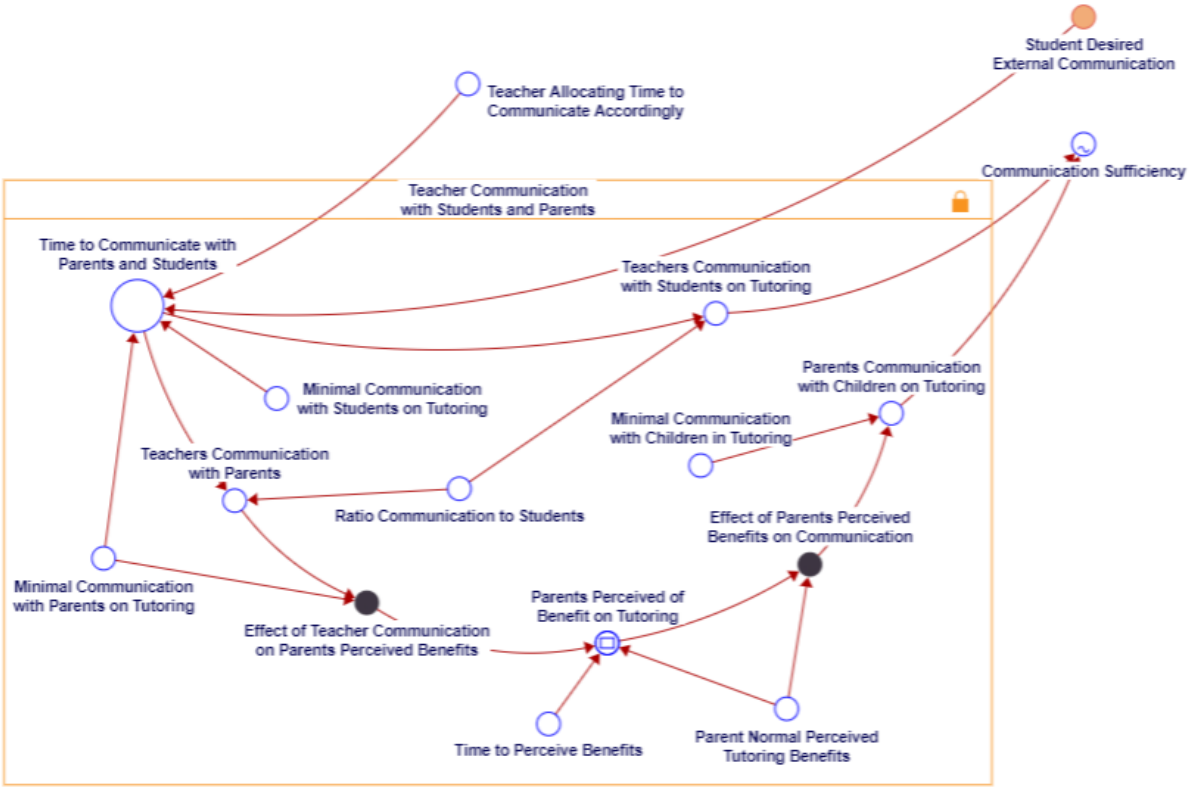
The desire to increase motivation does not only derive from a perceived motivation gap but also from a gap of student demand (in red) if not enough students are signing up. If there is any gap, the variable *implementation committee emphasizes communication to increase student demand* is activated through the following equation:

```
IF "Gap_of_Demand_(Students)">0 THEN 1 ELSE 0
```

Now for this extra communication time to be implemented, the actual motivation gap needs to be perceived bigger than the accepted motivation gap value of 0.2. To keep track of the effects, a policy switch has been added leading to the following equation:

```
Teacher_Allocating_Time_to_Communicate_Accordingly =
IF Implementation_Committee_Emphasizes_Communication_to_Increase_Student_Demand=1 THEN (IF
Teacher_Perceived_of_Student_Motivation_Gap>Accepted_Gap_Value_Between_Motivation THEN 1 ELSE
0) ELSE
IF Policy_Switch_Teacher_Time_Allocation_for_Monitoring_and_Communication=0 THEN 0 ELSE IF
Teacher_Perceived_of_Student_Motivation_Gap>Accepted_Gap_Value_Between_Motivation THEN 1 ELSE
0
```

Note that this extra time for communication is only activated in the weeks when the registration is active. When there is still a gap in current motivation and desired motivation in the weeks after the registration closes, the teacher will react by spending more time on monitoring. This will be further explained in the upcoming chapters.

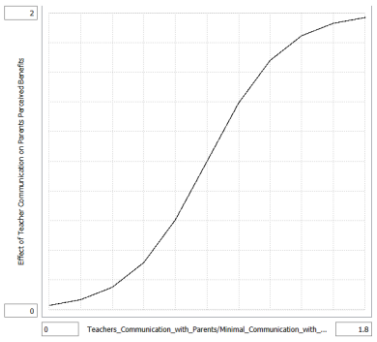


How this communication policy works is portrayed in the below equation:

```
Time_to_Communicate_with_Parents_and_Students =
IF Teacher_Allocating_Time_to_Communicate_Accordingly=1 THEN
Student_Desired_External_Communication+Minimal_Communication_with_Parents_on_Tutoring ELSE
Minimal_Communication_with_Students_on_Tutoring+Minimal_Communication_with_Parents_on_Tutoring
```

Of all the teacher's time allocated to communication, the time allocated for student communication is assumed to be higher compared to the time spend on communicating with the parents. The total communication time is divided accordingly by using a ratio of 0.6 for the students and (1-0.6) for the parents. The hours of *teacher's communication with students on tutoring* will then directly feed back into the variable *communication sufficiency* which was discussed in the previous chapter.

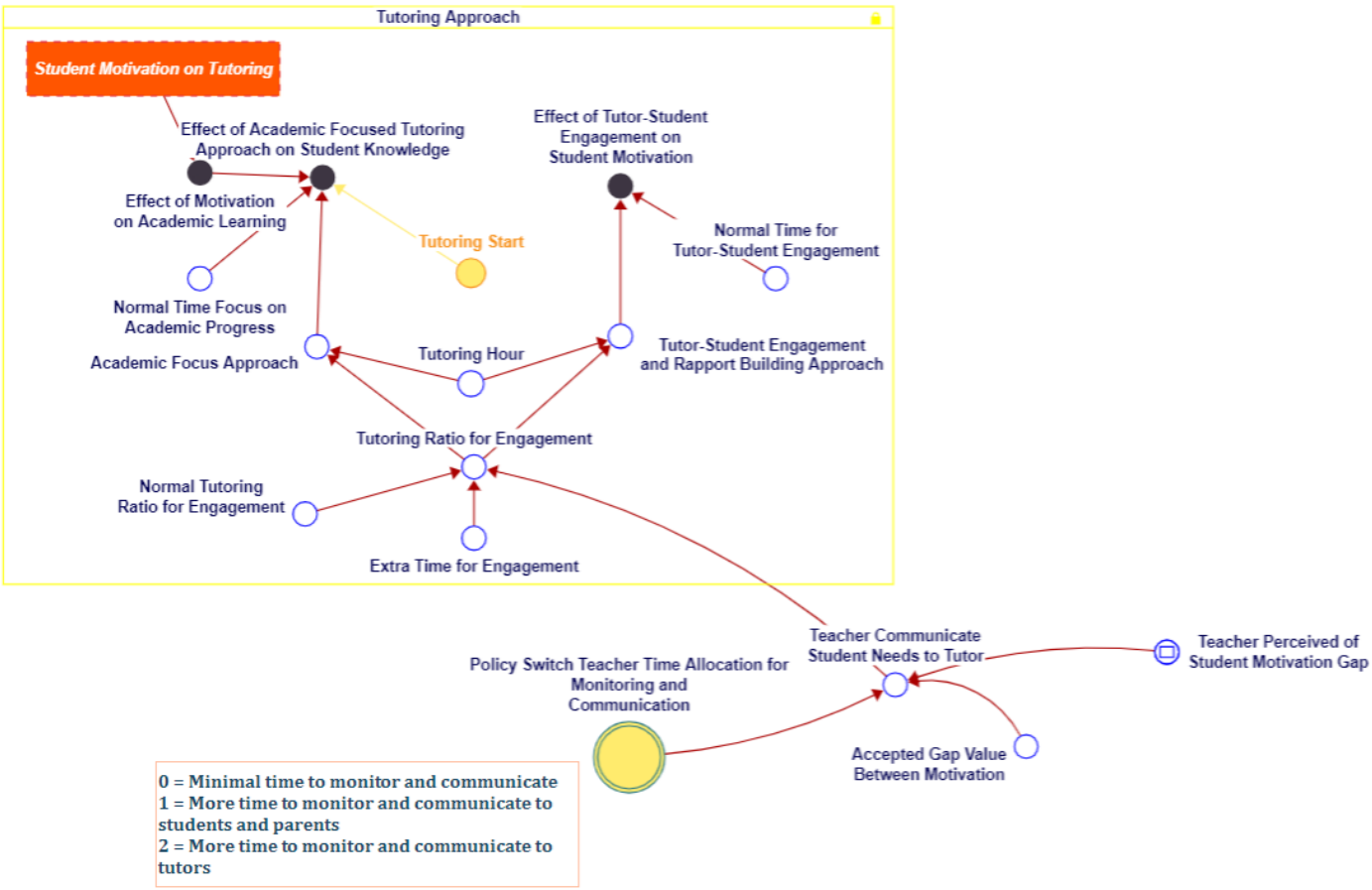
The time spend communicating with parents positively influences how the parents perceive the NLRP as indicated by the table function *effect of teacher communication on parents perceived benefits.* This effect is noticed by the parents after an assumed delay time of 2 weeks.



When the parents are enthusiastic about the NLRP, it is assumed they will therefore positively influence their children's opinion regarding the program through their communication. This is also represented in the model by a similar s-shaped table function in the variable *effect of parents perceived benefits on communication.* This effect is multiplied with assumed minimal communication with their children which in turn also feeds back to the variable *communication sufficiency.*

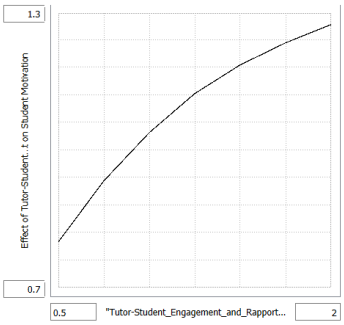
5.3.4. Tutoring Approach

In the previous chapter it was mentioned that the motivation gap perceived by the teacher could incentivize them to spend extra time on communicating with the parents and students. This was a short-term initiative to motivate the students to sign up for the program. A medium-term solution is for the teachers to spend extra time monitoring the students and communicating with the tutor.



When the policy is on to communicate more with the tutors, the tutor is made aware of the motivation gap and will therefore spend more attention on student engagement. The variable *tutoring ratio for engagement* is adjusted accordingly:

```
IF Teacher_Communicate_Student_Needs_to_Tutor=1 THEN
Normal_Tutoring_Ratio_for_Engagement*Extra_Time_for_Engagement ELSE
Normal_Tutoring_Ratio_for_Engagement
```



The value of the variable *extra time for engagement* is 2, meaning double the time will be allocated to student engagement and less time is allocated to academic progress until motivation has increased. The motivation is increased by via a table function in the variable *effect of tutor-student engagement on student motivation* which feeds back into the motivation section.

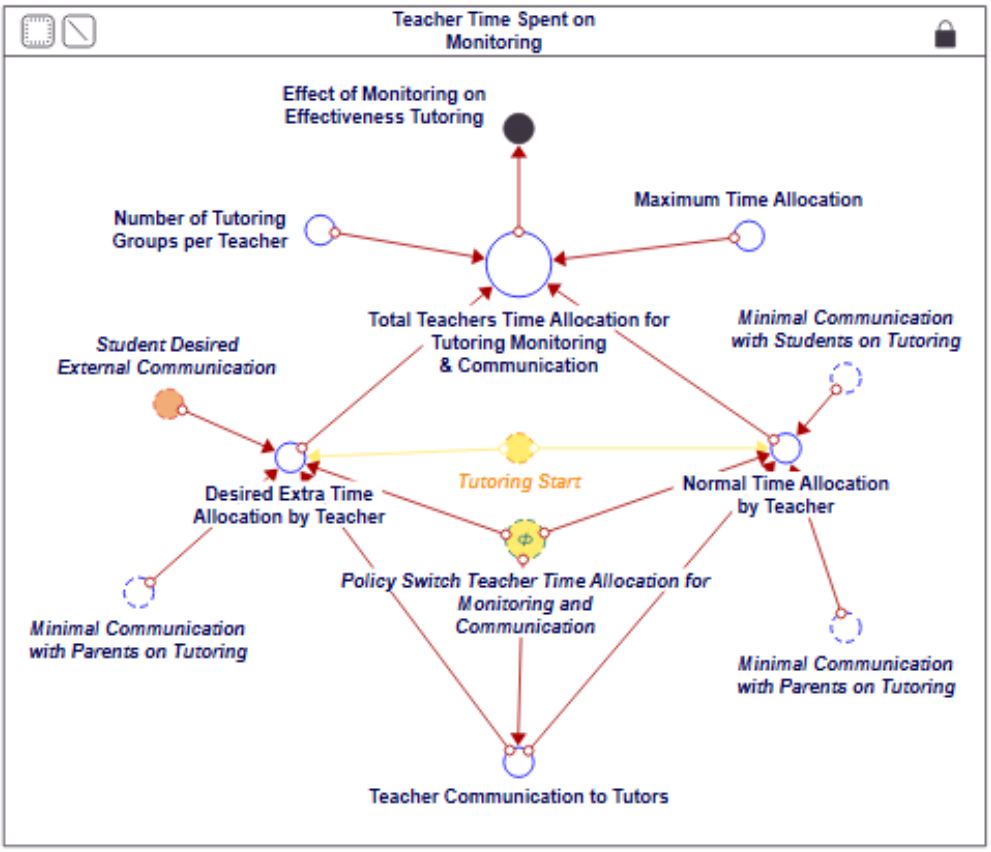
If time is not spent on building student engagement, it is spent on academic progress. This is what will directly influence the knowledge of the students. For knowledge to increase however, the students must be willing to learn. Which is represented here by the stock *student motivation on tutoring* in the upper left corner of the structure. The variable *effect of academic focused tutoring approach on student knowledge* will

directly feed back into the expected knowledge adjustment rate discussed in chapter 5.0. The equation of that variable is as follows showing how it takes academic study time and motivation in consideration:

```
IF Tutoring_Start=0 THEN 0 ELSE (Academic_Focus_Approach/
Normal_Time_Focus_on_Academic_Progress*Effect_of_Motivation_on_Academic_Le
arning)
```

5.3.5. Teacher Monitoring

This sector illustrates total teacher time spent to coordinate and monitor tutoring depending on whether the short- or medium-term strategy is activated.



The portrayed policy switch also mentioned in the previous chapter determines if extra time is spent on monitoring and communicating with the tutors per the below equation.

```
Teacher_Communication_to_Tutors =
IF
Policy_Switch_Teacher_Time_Allocation_for_Monitoring_and_Communication
=2 THEN 0.4 ELSE 0
```

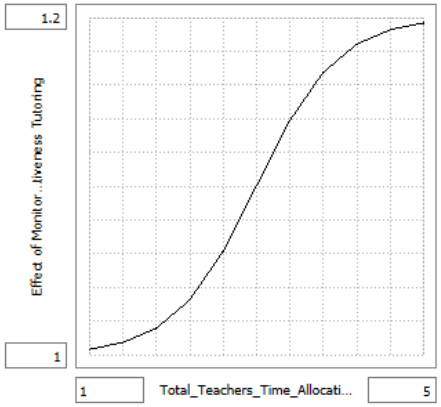
This variable, *teacher communication with tutors,* feeds into both the desired time allocation of the teacher and the normal time allocation. The *desired extra time allocation by teacher* simply adds up all the desired time variables and the *normal time allocation by teacher* adds up the minimum time variables. Both variables depending on what policy switch is currently selected as portrayed in the below equation:

Desired_Extra_Time_Allocation_by_Teacher = A

```
IF  Tutoring_Start=0 THEN 0 ELSE IF Policy_Switch_Teacher_Time_Allocation_for_Monitoring_and_Communication=1 OR
Policy_Switch_Teacher_Time_Allocation_for_Monitoring_and_Communication=2 THEN
(Student_Desired_External_Communication+Minimal_Communication_with_Parents_on_Tutoring+Teacher_Communicatio
n_to_Tutors) ELSE 0
```

The variable *total teacher's time allocation for tutoring monitoring and communication* ensures the monitoring time per group does not exceed the maximum time allocation.

When more time is spent on monitoring, the teacher will gain more detailed information on the progress of the students and will therefore be able to give better instructions to the tutors on what problem areas to focus on per student. Therefore, it is assumed that the effectiveness of the tutoring sessions increases when monitoring time increases. This is set in motion by the table function variable *effect of monitoring on effectiveness tutoring.* This is assumed to have an s-shape as there is a cap on the effectiveness of tutoring. This effect variable directly influences the *expected knowledge adjustment rate* as will be explained in the next chapter.

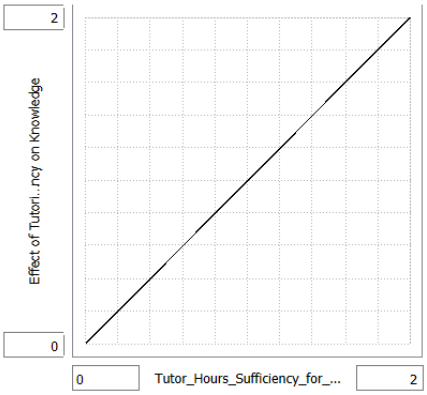


5.4 Connecting the Model

5.4.1. Expected Knowledge Adjustment Rate

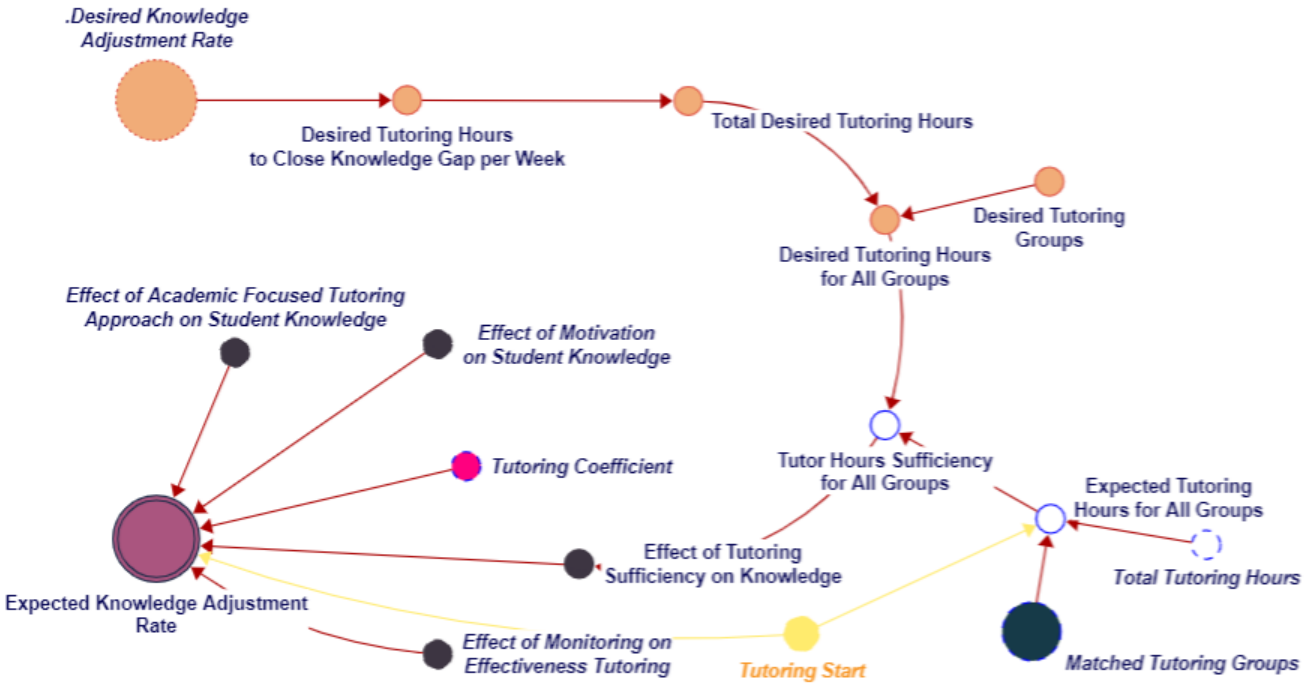
The structure in this chapter discusses how all the sectors from the previous chapters link back to the *expected knowledge adjustment rate.* The desired adjustment rate feeds into the sub-model from the explanatory model. Using this variable, the *total desired tutoring hours* and *desired tutoring hours for all groups* is calculated. The image below shows a simplified structure of this section for clarity purposes.

The variable *matched tutoring groups* (lower right corner) that was discussed previously is used to calculate the *expected tutoring hours for all groups* by simply multiplying it with the total tutoring hours. This variable is then divided by the *desired tutoring hours for all groups* which leads to a value indicating the sufficiency of the actual tutoring hours. The higher this value is, the more beneficial effects it will have on the *expected knowledge adjustment rate.* This is represented in the table function *effect of tutoring sufficiency on knowledge* as seen on the right.



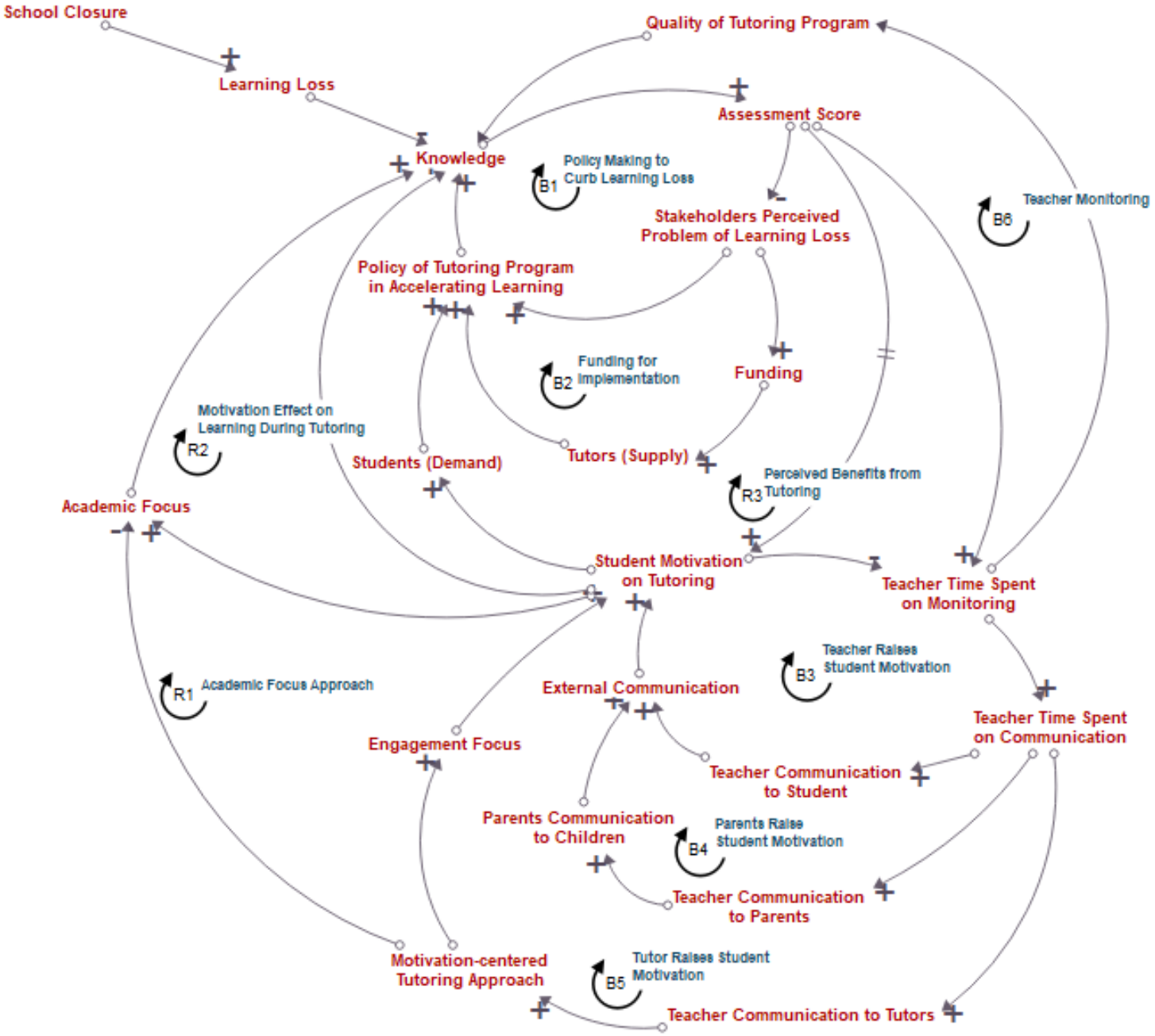
To finally arrive at the value of the *expected knowledge adjustment rate*, the effect of the sufficiency of the tutoring hours is multiplied with the effects that were mentioned in previous chapters and with the *tutoring coefficient* as can be seen in the equation below. This coefficient represents the knowledge increase tutoring sessions would contribute under normal conditions. Under these conditions, each week, there is a knowledge increase of 0.2975 (Anderson, 2020).

```
Expected_Knowledge_Adjustment_Rate =                                    A
IF Tutoring_Start=0 THEN 0 ELSE
Tutoring_Coefficient*Effect_of_Tutoring_Sufficiency_on_Knowledge*Effect_of_Motivation_on_Student_Kn
owledge*Effect_of_Academic_Focused_Tutoring_Approach_on_Student_Knowledge*Effect_of_Monitoring_
on_Effectiveness_Tutoring
```



6. Causal Loop Diagram

The causal loop diagram shows how all the sections in the model link together. The table beneath the diagram provides information regarding the variables in each feedback loop.



B1	**Policy Making to Curb Learning Loss**	School Closure – Learning Loss – Knowledge – Assessment Score – Stakeholders Perceived Problem of Learning Loss – Policy of Tutoring Program in Accelerating Learning - Knowledge
B2	**Funding for Implementation**	School Closure – Learning Loss – Knowledge – Assessment Score – Stakeholders Perceived Problem of Learning Loss – Funding – Tutor (Supply) - Policy of Tutoring Program in Accelerating Learning - Knowledge
B3	**Teacher Raises Student Motivation**	Assessment Score – Teacher Time Spent on Monitoring - Teacher Time Spent on Communication – Teacher Communication to Student – External Communication – Student Motivation on Tutoring – Student (Demand) – Policy of Tutoring Program in Accelerating Learning – Knowledge - Assessment Score
B4	**Parents Raise Student Motivation**	Assessment Score – Teacher Time Spent on Monitoring - Teacher Time Spent on Communication – Teacher Communication to Parents – Parents Communication to Student - External Communication – Student Motivation on Tutoring – Student (Demand) – Policy of Tutoring Program in Accelerating Learning – Knowledge - Assessment Score
B5	**Tutor Raises Student Motivation**	Assessment Score – Teacher Time Spent on Monitoring - Teacher Time Spent on Communication – Teacher Communication to Tutors – Motivation-centered Tutoring approach - Student Motivation on Tutoring – Teacher Time Spent on Monitoring
R1	**Academic Focus Approach**	Assessment Score – Teacher Time Spent on Monitoring - Teacher Time Spent on Communication – Teacher Communication to Tutors – Motivation-centered Tutoring approach – Academic focus – Knowledge - Assessment Score
R2	**Motivation Effect on Learning during Tutoring**	Student Motivation on Tutoring – Academic Focus – Knowledge – Assessment Score - Student Motivation on Tutoring
R3	**Perceived Benefits from Tutoring**	Assessment Score – Student Motivation on Tutoring – Knowledge – Assessment Score

7. Discussion and Conclusion

Some assumptions that were made in this model require more research to represent reality more accurately. For example, it is assumed that 30% of the school teachers would join the NLRP as a tutor. This assumption may be too optimistic and would require additional research.

Another example is the assumption of the implementation timeframe of the policy. As this is a large-scale nation-wide operation, it will likely require more preparation time to get the NLRP up and running. However, considering the urgency of the problem, these assumptions were made with the intention to ensure that the knowledge gap was significantly reduced by the end of the school year. Realistically, this may not be possible.

The model boundary is considered to be adequate for the purpose of the model which is to consider what effects a NLRP would have on the knowledge level of primary school students. However, additional model structure could be included to provide more accurate information. For example, a more detailed accounting structure could be developed to represent in detail how the program is funded and how that money is distributed.

To conclude, the model provides useful insights in how the knowledge level of the students is affected by extra tutoring sessions. It also contributes to increase the understanding of the impact of school closures on the academic performance of the students. These insights provided by the model could be beneficial in the short-term, but the model can also serve as a stand-by framework to be put in use if school closures may be required again in the future.

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